

OPERATION MANUAL

MAGNETIC SUSPENDED COMPOUND MOLECULAR PUMP / CONTROLLER

TG710M / TG713M / TD711/1111-C
TG710EM / TG713EM / TD711/1111-C
TG730M / TG733M / TD711/1111-C
TG730EM / TG733EM / TD711/1111-C
TG1110M / TG1113M / TD711/1111-C
TG1110EM / TG1113EM / TD711/1111-C
TG1130M / TG1133M / TD711/1111-C
TG1130EM / TG1133EM / TD711/1111-C
TG2000M / TG2003M / TD2001-C
TG2810EM / TG2813EM / TD3211-C
TG3210EM / TG3213EM / TD3211-C
TG3410EM / TG3413EM / TD3211-C

Issue date 05.10.'98

Approved	Checked	Issued
M.Iguchi	M.Sakurai	T.Nakayasu

For a safe operation, be sure to read this manual before operating the pump.
This is an important operation manual. Store it safely for a future reference.

OSAKA VACUUM, LTD.

OSAKA VACUUM, LTD.

Important : For a safe pump operation, please be sure to read this manual before any pump operations.

Operations not following the procedures in this manual may result in a failure, or an accident involving injury or electrical shock.

1) Pump Installation

Operate the pump after securing the pump in a rack or onto the floor.

When the pump is used in a system, design the system after reading this manual thoroughly.

2) A Combination of the Pump and the Power Supply.

A proper combination between the pump and a power supply is required.

Select a type of power supply specified on the nameplate at the pump connector.

3) Input Power

Select an isolated source with a low noise, surge and a good voltage regulation.

All models must only be connected to a power source or system that is adequately isolated(floating) from ground and never to a mains-type(branch circuit) supply.

Connection to any other supply will render the equipment unsafe in terms of lethal electrical shock. To achieve the required isolation a suitable safety isolation transformer must be incorporated in the host equipment or system to which the pumps and power supplies are to be used. The transformer secondary circuit must be separated from ground according to the requirements of basic isolation, and all components connected between the transformer and the Pump Power Supply must be NRTL recognized/listed.

4) Grounding

Be sure to connect the protective ground "E" of the "INPUT" connector of the power supply.

Connect frame / body of pump to the protective ground "E".

5) Start and Stop

To start or to stop the pump, use the START , STOP buttons on the power supply or the Start / Stop signal led through the "REMOTE" connector of the power supply.

DO NOT disconnect cables during the pump operation.

When performing a start/stop repeated operation, leave at least 5 seconds of intervals.

DO NOT operate the pump using the input power's ON/OFF.

6) Gas Purge

When pumping reactive or corrosive gases, be sure to perform the gas purge to the pump.

7) Check

When the power supply is to be checked, remove the input power and wait at least for 5 minutes before performing the work.

DO NOT insert your hand(s) or any objects in the pump.

8) Backing Pump

Be sure to always connect a backing pump to the Magnetic Suspended type Compound Molecular Pump.

9) Pumped Gases

DO NOT pump Gallium and its compounds. It may damage the pump.

10) Disassembly and Modification

DO NOT disassemble and/or modify the pump, power supply and cables. It may result in failures or accidents and fails safety.

Caution and Warning signs throughout in this manual.

! CAUTION : An important consideration is described in order to operate the pump and the power supply safely.

! WARNING : An important consideration is described in order to avoid any injuries or a risk of electrical shock when operating the pump and the power supply.

Attached Drawings Summary

1. Magnetic Suspended Compound Molecular Pump Outside Drawings(Appearance)
2. Power Supply Outside Drawing
3. Cable Connection
4. Power Supply I/O Communications

CONTENTS

	Page
1. Preface -----	5
1-1. Warranty	
1-2. The nameplates on the pump and the power supply	
2. Opening the Crate -----	6
3. Preparation -----	6
3-1. Carrying	
3-2. Combinations between the pump and the power supply	
3-3. Pump installation	
3-4. External environment of the pump	
3-5. The power supply installation and securing	
3-6. External environment of the power supply	
4. Vacuum Piping -----	10
4-1. Inlet port piping	
4-2. Foreline piping	
4-3. Setting for the backing pump	
4-4. Purge gas piping	
5. Electrical Connections -----	11
5-1. Output cable connections	
5-2. Fan cable connections	
5-3. Input power cable connections	
5-4. Remote signal connections	
5-5. Serial interface connection	
6. Operation -----	15
6-1. Operation precautions	
6-2. Start and stop of the MS type CMP	
6-3. Start and stop of the MS type CMP during acceleration/deceleration	
6-4. The variable rotation speed feature of the MS type CMP	
6-5. Serial interface	
7. Baking -----	23
8. Protection Feature -----	23
8-1. Power failure	
8-2. Protection circuitry	
8-3. Resetting the error display	
9. Troubleshooting -----	27
10. Maintenance -----	28
10-1. Protection bearings	
10-2. Reactive products	
10-3. Parts deterioration	
11. Storing the Pump and the Power Supply -----	29

1. Preface

1-1. Warranty

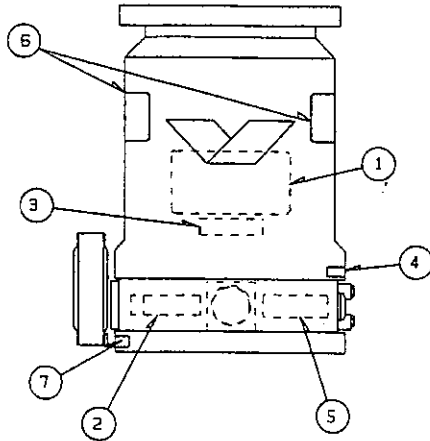
The warranty on the pump, the power supply and the peripherals are specified in the document, "General Terms of Warranty" published by OSAKA VACUUM, LTD., provided that the warranty will be avoided if the operations and the maintenance procedures in this manual are not followed.

Note, also, that any special use of the pump and the power supply without OSAKA VACUUM, LTD's agreement will avoid the warranty.

1-2. The nameplates on the pump and the power supply

A. Pump Nameplate

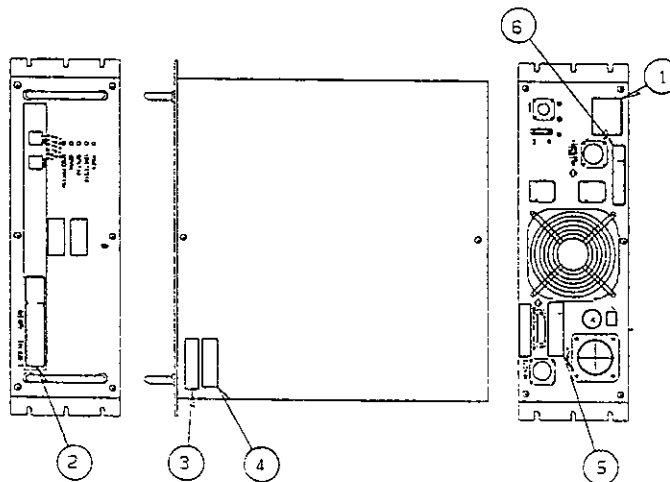
Example: TG730M



- ① Main Plate Specifies pump type, manufacturing number, manufacturing date
- ② Power Supply Type Plate: Specifies the type of power supply to be used.
- ③ Caution Plate: Specified the pump weight
- ④ Caution Plate: "FORELINE"
Be sure to connect to a backing pump.
- ⑤ Caution Plate: "Do not disconnect the cable, while the pump is in operation."
- ⑥ Caution Plate: During operation, the pump is heated up.
Do not touch the pump casing.
- ⑦ Caution Plate: "Connect only as stipulated in the instruction manual. This interface is not safe-to-touch and must only be connected through the proper isolation."

B. Power Supply Nameplate

Example: TD711/1111-C



- ① Main Plate Power supply's type, manufacturing number, manufacturing date are specified.
- ② Power Supply Type Plate Use the pump and the power supply in a correct combination.
- ③ Caution Plate Specified the power supply's weight.
- ④ Caution Plate "Never touch the Power Supply inside with power on"
- ⑤ Caution Plate "Do not disconnect the cable, while the pump is in operation."
- ⑥ Caution Plate "Prior to operation, please read the instruction manual carefully."

2. Opening the Crate

Confirm the following items when opening the crate.

A. Any damages to the contents

If any damages are found, notify OSAKA VACUUM, LTD. before use.

B. Attachment parts and spare parts

The standard shipping should include the following attachment and spare parts.

- | | |
|--|---|
| (1) Output cable | 1 |
| (2) Fan cable (for air cooling pump) | 1 |
| Fan connector (for water cooling pump) | 1 |
| (3) Remote connector | 1 |
| (4) Input cable | 1 |
| (5) Operation manual | 1 |

3. Preparation

3-1. Carrying

- a. Protect the pump and power supply from impact.
- b. Use the lifting bolts and hoist when carrying and removing pump from equipment for service adjustment or replacement.

Pump Type	Weight (kg)
TG710M/710EM/713M/713EM/1110M/1110EM/1113M/1113EM	~38
TG730M/730EM/733M/733EM/1130M/1130EM/1133M/1133EM	~38
TG2000M/2003M	~70
TG2810EM/2813EM/3210EM/3213EM/3410EM/3413EM	~120

- c. When you carry the power supply, please hold it securely with both hands. (weight ~23 kg)

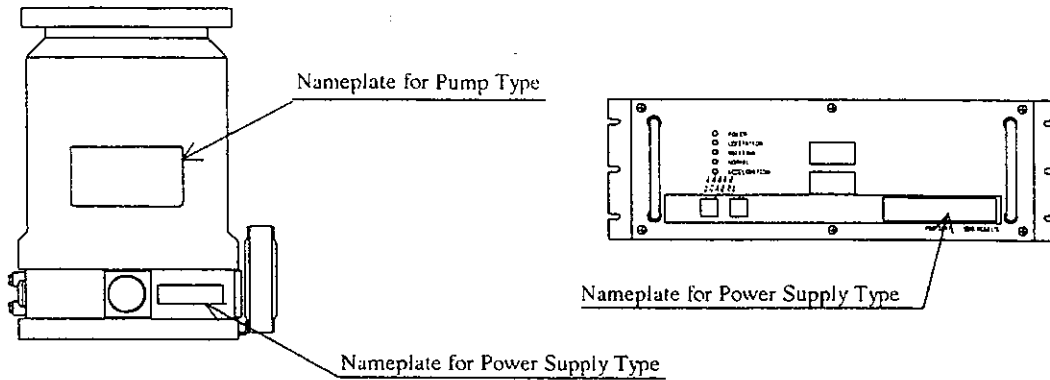
3-2. Combinations between the pump and the power supply

! CAUTION

Confirm the types for both the pump and the power supply before installation.

The nameplate at the pump connector shows the type of power supply to be used.

Also, the power supply has a nameplate showing the type. Be sure to use the same type.



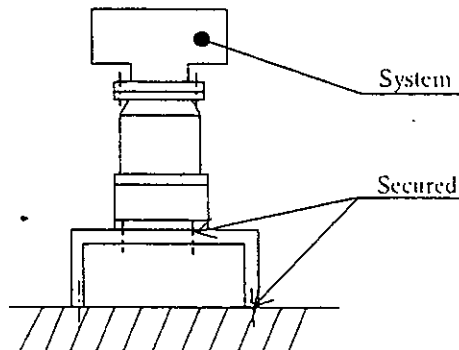
The Combinations between the Pump and the Power Supply are as follow.

Pump Type	Power Supply Type
TG710M/713M/1110M/1113M	TD711/1111-C
TG710EM/713EM/1110EM/1113EM	TD711/1111-C
TG730M/733M/1130M/1133M	TD711/1111-C
TG730EM/733EM/1130EM/1133EM	TD711/1111-C
TG2000M/2003M	TD2001-C
TG2810EM/2813EM/3210EM/3213EM/3410EM/3413EM	TD3211-C

3-3. Pump installation

! CAUTION

Secure the pump not only to the system at the inlet flange but also to the frame utilizing the bolt holes prepared for securing the pump at the bottom. The frame the pump is secured to must be secured to the floor.



! WARNING : If an accident occurred during an pump operation, a damage to the pump rotor will generate a large rotation torque. Since this torque will try to rotate the entire pump, in order to avoid any danger, the pump must be secured to the frame firmly.

When designing the system and the frame and securing it to the floor, refer to the Table 1. for Rotation Torque.

Pump Type	Rotation Torque (N m)
TG710M/710EM/713M/713EM/1110M/1110EM/1113M/1133EM	1620
TG730M/730EM/733M/733EM/1130M/1130EM/1133M/1133EM	1620
TG2000M/2003M	5150
TG2810EM/2813EM/3210EM/3213EM/3410EM/3413EM	8400

Table 1. Rotation Torque that can be generated when the pump is damaged.

Table 2. shows the size and the number of securing bolts at the bottom of the pump.

Pump Type	Securing Bolts	P.C.D.
TG710M/710EM/713M/713EM/1110M/1110EM/1113M/1113EM	4 x M10	220
TG730M/730EM/733M/733EM/1130M/1130EM/1133M/1133EM	4 x M10	220
TG2000M/2003M	4 x M16	250
TG2810EM/2813EM/3210EM/3213EM/3410EM/3413EM	4 x M16	250

Table 2. Securing bolts at the bottom of the pump

When securing the pump to the system, use Table 3. specified bolts and tighten all the bolts.

Pump Type	Flange Type	Securing Bolts
TG710M/710EM/713M/713EM	VG	6 x M10
TG730M/730EM/733M/733EM	CF	20 x M8
	B	8 x M10
TG1110M/1110EM/1113M/1113EM	VG	8 x M10
TG1130M/1130EM/1133M/1133EM	CF	24 x M8
	B	12 x M10
TG2000M/2003M	VG	12 x M12
TG2810EM/2813EM	B	12 x M10
TG3210EM/3213EM	VG	12 x M12
	B	12 x M12
TG3410EM/3413EM	VG	12 x M12

Table 3. The number and the size of the securing bolts for the pump inlet flange.

3-4. External environment of the pump

1) Surrounding temperature of the pump should not exceed 40°C during the pump operation.

! WARNING : During the pump operation the pump will generate heat. If the external temperature exceeds 40°C, it may lead to a failure.

2) Magnetic fields

DO NOT operate the pump in a strong magnetic fields. During an operation, maximum magnetic fields are 0.003[T](=30[Gauss]).

! WARNING : If the pump is operated in strong magnetic fields, the rotor temperature will rise and this may lead to a short life of the rotor or to a failure of the pump.

3) DO NOT apply any shocks or vibrations from the external to the pump.

3-5. The power supply installation and securing

The power supply can be installed either in a rack. If it's installed in a rack, support its weight with either a rail or a plate.

! CAUTION : Weight of the power supply is about 23 kg.
Rack-mount only.

3-6. External environment of the power supply.

DO NOT operate the power supply in the following environment.

- 1) High temperature, high humidity.
- 2) Under a water dripping spot.
- 3) A place with explosive or flammable gases.
A place with corrosive or toxic gases.
A dusty place.
- 4) A place with strong magnetic or electric fields.
- 5) A place with vibrations.
- 6) DO NOT cover the cooling fan at the rear of the power supply.

! WARNING : Leave space to the wall at the rear and the bottom of the power supply for ventilation. Otherwise, the temperature in the power supply may rise and may lead to a failure.

4. Vacuum Piping

4-1. Inlet port piping

- 1) Use a material with a small out gassing rate such as stainless steel and aluminum alloy for the piping.
- 2) Design the piping considering the conductance.
- 3) Minimize the leak rate of the piping and the system. Degrease the pump inner walls in order to minimize the out gas.
- 4) When the pump is installed to a system, DO NOT remove the protective screen at the inlet port in order to prevent any foreign objects falling into the pump.

! WARNING : Even with a protective screen, foreign objects may fall into the pump.
When this happens, it could damage the pump.

4-2. Foreline piping

- 1) Use materials for piping such as stainless steel, aluminum, metal flexible tubing, etc. to connect the pump to a backing pump.
- 2) The length and the diameter of the piping will affect the pump performance. Minimize the pipe length and maximize the diameter.

4-3. Settings for the backing pump

- 1) Depending on the capacity of the backing pump, the performance of the Magnetic Suspended Compound Molecular Pump (hereafter abbreviated as MS type CMP) varies. Refer to Table 4. for the backing pump selection. Suggested pump capacities are shown. Use a backing pump that has a capacity in this suggestion or higher.

Pump Type	Suggested Pump Capacity (m ³ /h)
TG710M/710EM/713M/713EM/1110M/1110EM/1113M/1113EM	15(=250[L/min])
TG730M/730EM/733M/733EM/1130M/1130EM/1133M/1133EM	15(=250[L/min])
TG2000M/2003M	30(=500[L/min])
TG2810EM/2813EM/3210EM/3213EM/3410EM/3413EM	90(=1500[L/min])

Table 4. Suggested backing pump capacities

! CAUTION : If the performance of the backing pump deteriorates, the performance of the MS type CMP deteriorates, too.

- 2) Use a flexible tubing or bellows to reduce the vibrations of the backing pump conducted to the MS type CMP. When installing the backing pump, place it either separately from the molecular pump or use some vibration absorption device if installed together in the same frame.

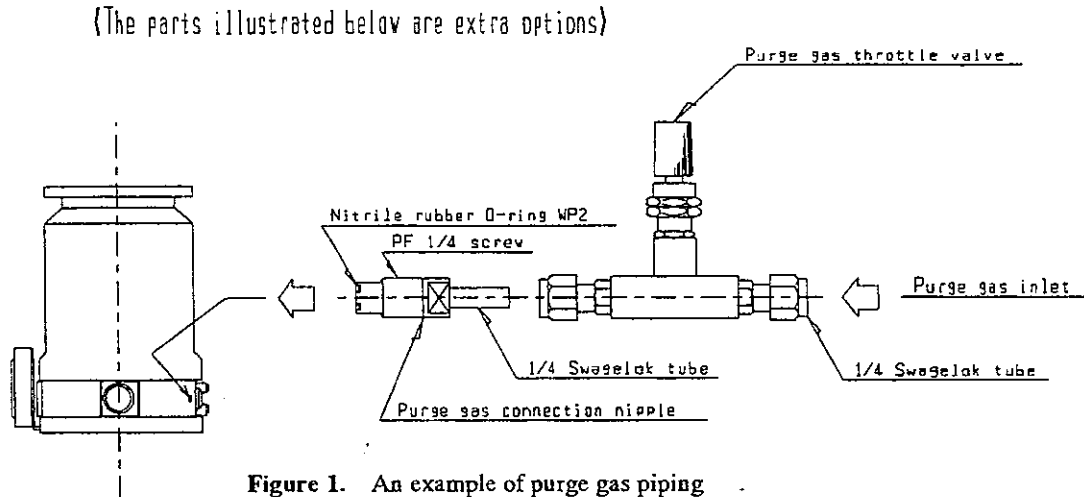
4-4. Purge gas piping

When reactive gases, corrosive gases or dust are pumped, perform a gas purge.

As to the gas purge piping, refer to Figure 1.

N₂ is commonly used as a gas purge. Set a flow rate 33.8[Pa·L/s](=20[scm]).

! WARNING: Excessive or insufficient purge gas flow rate may lead to a deterioration of the MS type CMP or a failure.



5. Electrical Connections

The cable connections between the MS type CMP and its power supply are shown in Figure 2.

Example: TG730M&TD711/1111-C

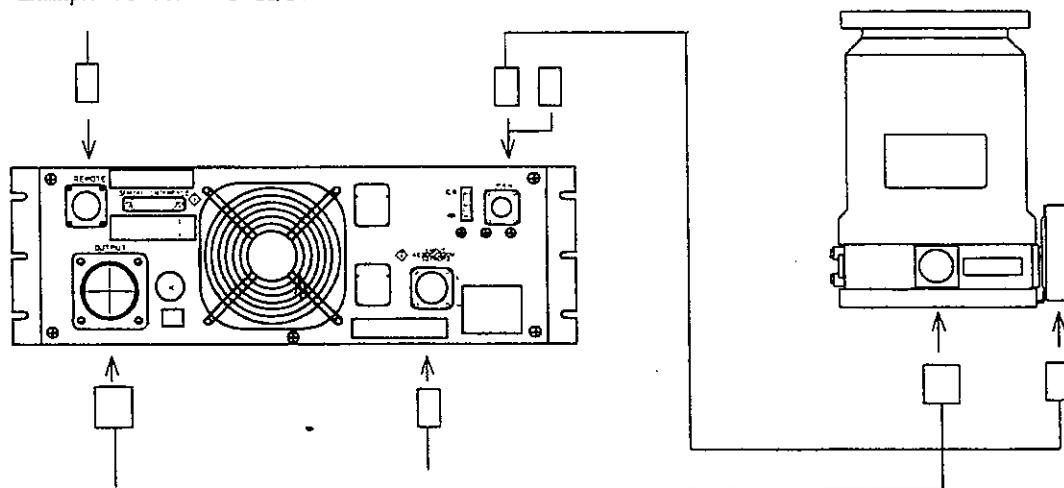


Figure 2. Cable connections between the pump and the power supply

5-1. Output cable connections

Using the output cable (provided in the package), connect the MS type CMP and "OUTPUT" at the rear of the power supply.

5-2. Fan cable connections

If the molecular pump is an air cooling type, using the fan cable (provided in the package), connect the cooling fan of the molecular pump and "FAN" at the rear of the power supply.

If the molecular pump is a water cooling type, insert the fan connector (provided in the package) to "FAN" at the rear of the power supply.

5-3. Input power cable connections

Connect the input power cable (provided in the package) to "INPUT" at the rear of the power supply.

Input power is AC200/220V, 50/60Hz, Single Phase.

<p>! CAUTION : Be sure to connect "Ground" of the input power cable. To ensure operator safety, this equipment must only be supplied from an isolated power source.</p> <p>! WARNING : When applying a voltage to the power supply, do NOT touch any inner components. There is a high risk of electrical shock.</p> <p>! CAUTION : Insert connectors thoroughly and firmly.</p>

5-4. Remote signal connections

MS type CMP can be locally operated via signals from the START and STOP buttons on the front panel of the power supply or remote-controlled via signals from the system.

1) Local operation

The START and STOP buttons on the front panel of the power supply are pressed for the pump start and stop in the local operation.

Even when the local operation is used, the "REMOTE" connector at the rear of the power supply is still used. Feed a protection signal between pins 5-6 of the "REMOTE" connector as necessary.

Protection signal refers to an interlock signal in the following situations.

- When you want to stop the molecular pump because the foreline pressure of the pump became too high.
- When you want to stop the molecular pump because the cooling water supply to the pump is shut off.

This protection signal is fed between pin 5 and pin 6 of "REMOTE" connector such that the logic is normally closed.

When a protection signal is not used, a shortage between pin 5 and pin 6 of the "REMOTE" connector is required. Otherwise, power supply's "Failure" is lit and the pump cannot be started up.

Initially, at the time of shipping, the pin 5 and 6 are shorted of the "REMOTE" connector.

2) Remote operation

At the "REMOTE" connector, the following signals are used to communicate with the system.

Refer to Figure 3. for wiring.

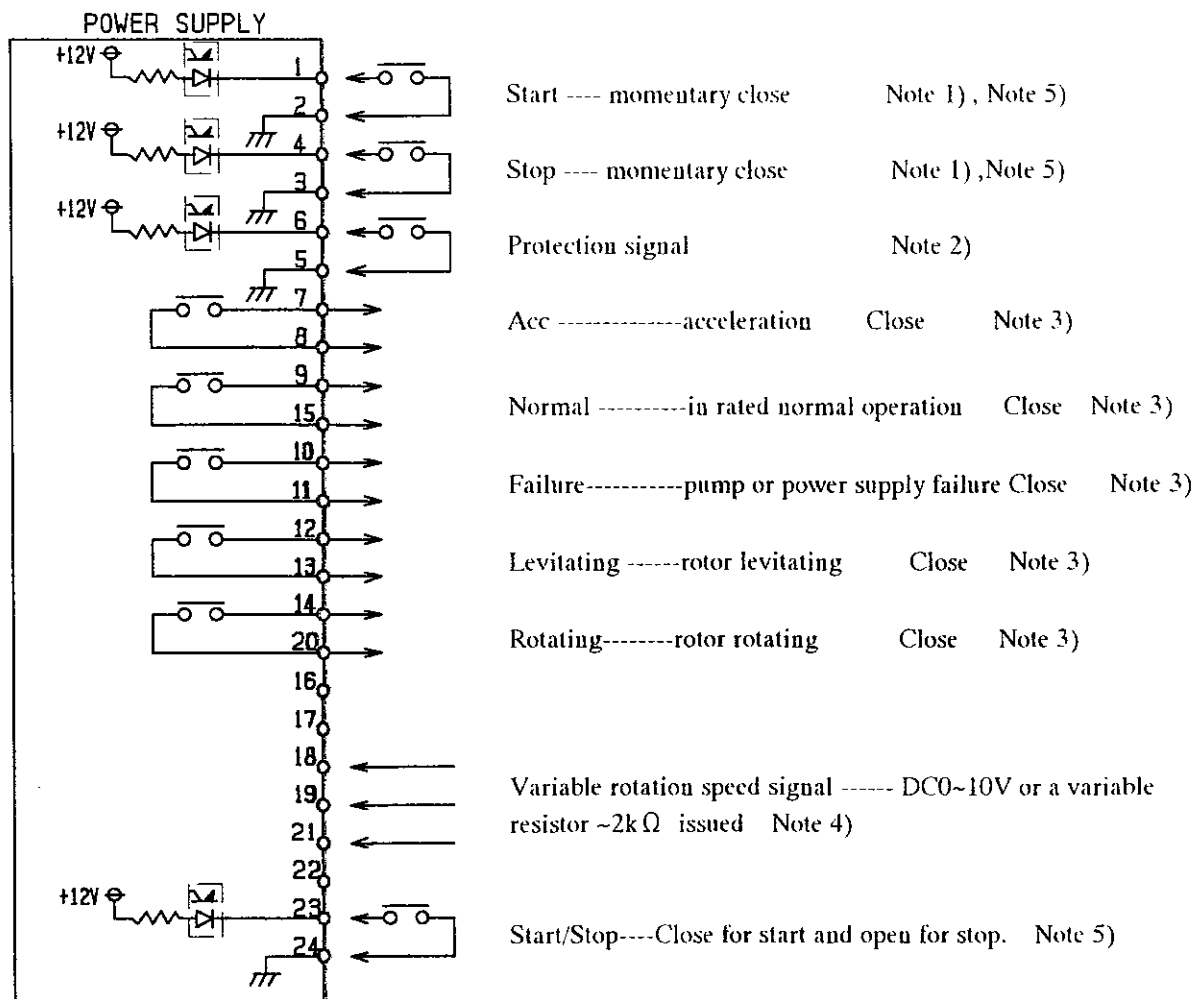
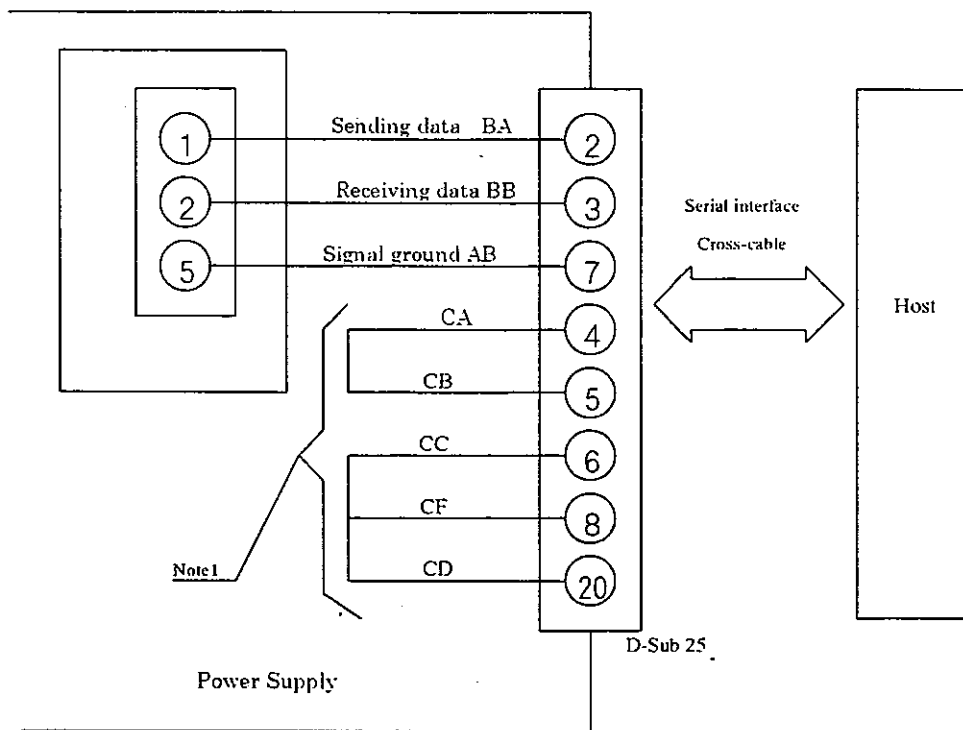


Figure 3. The remote signal communication

- Note 1) Use momentary contacts (more than 0.5 sec) for start and stop signals.
- Note 2) Connect the protection signal lines in the same way as in the local operation. If left open, the power supply's error will be turned ON and the pump cannot be started.
- Note 3) These signals are for the no-voltage contacts. The contacts are rated AC110V/0.2A, DC24V/0.3A.
- Note 4) Refer to section 6-4. on how to use this.
- Note 5) For the remote operation, use either start and stop signals on pins 1-2 and 3-4 or start/stop signals on pins 23-24.
- Note 6) All signal interface connections are low voltage but are not safety isolated from neither the high voltage supply nor motor output connections. (not safety isolation from internal circuit)

5-5. Serial interface

Use a cross-cable for serial interface.



Serial interface connection

Note 1

Handshake is never carried out on the power supply's side. (Power supply sends no output signal for handshake.)

The SERIAL INTERFACE dose not have the status "safe-to-touch" and must never be made accessible to personnel, or connected to circuits that are accessible to personnel. Connection to safe-to-toch (SELV) circuits such as RS232 interfaces etc. must be made only with devices of sufficient isolation, for example optical isolators. This additional isolation must at least satisfy the requirements of BASIC insulation at 220V. Failure to observe these precautions will render the equipment unsafe in terms of the risk of lethal electrical shock.

6. Operation

6-1. Operation precautions

MS type CMP can be started together with the backing pump.

If the volume of the chamber the molecular pump's inlet is connected to is large, however, during the acceleration "Failure" LED may come ON on the power supply and the pump may stop. In this case, follow the next procedure.

If the chamber pressure of 300 Pa on the system could not be obtained within 15 minutes using only the backing pump, then pump the chamber to 300 Pa first using the backing pump and then startup the molecular pump.

1) MS type CMP needs to be cooled during its operation.

- For air cooling Molecular Pumps,

Using the supplied cable, securely connect the cooling fan for the molecular pump and the "FAN" connector at the rear side of the power supply. This will allow the fan to be turned ON when the pump is started.

- For water cooling molecular pumps,

Connect the cooling water line to the cooling water inlet on the molecular pump. Use the best available clean water as the cooling water. Be sure to have an interlock so that if the cooling water supply stops or the flow rate becomes too low, the molecular pump will stop automatically. **The minimum required cooling water is 1.5 L/min and the cooling water temperature range to be 10 ~ 35 °C.**

! CAUTION : Insufficient cooling of the MS type CMP may result in a failure of the pump.

2) When reactive gases or corrosive gases are pumped, purge the pump with a purge gas. Flow rate of the purge gas is about 33.8[Pa · L/s](=20[sccm]). N₂ is typically used as the purge gas.

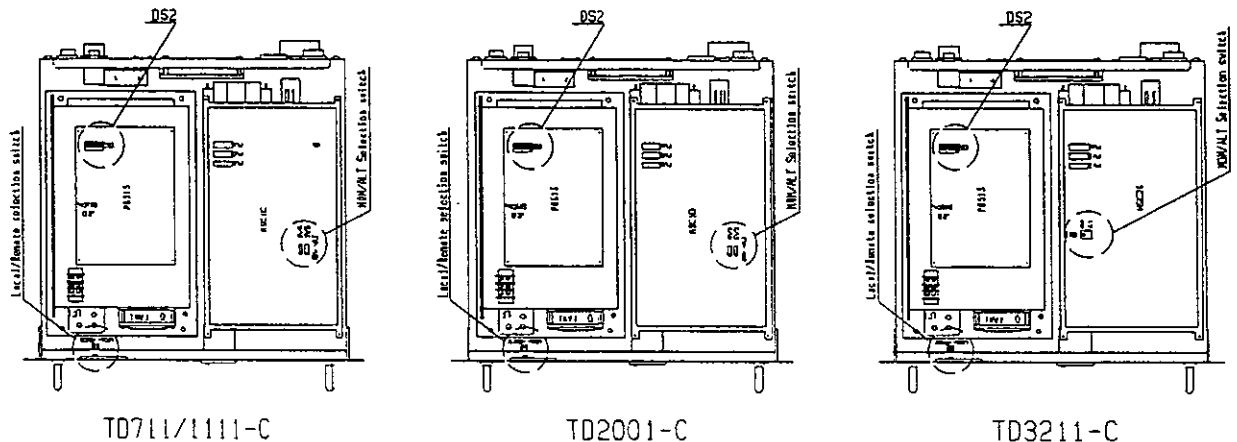
! WARNING : Excessive or insufficient purge gas flow rate may result in a lower pumping performance or a failure of the molecular pump.

3) Confirm the combination between the molecular pump and the power supply.

4) Make a selection on the Local / Remote switch in the power supply.

The power supply can be operated via signals from the START and STOP buttons on the front panel or remote controlled via signals from the system.

Prior to operation, set the LOCAL/REMOTE select switch inside of the power supply.



A. LOCAL mode operation

The START and STOP buttons on the front panel of the power supply are pressed for the pump start and stop.

- a. The LOCAL/REMOTE select switch in the power supply is set to LOCAL.
- b. MOM/ALT select switch is set to MOM.

B. REMOTE mode operation

a. When using momentary contacts on pins 1-2 and pins 3-4 for start and stop signals.

- The LOCAL/REMOTE select switch in the power supply is set to REMOTE.
- MOM/ALT select switch is set to MOM.

b. When using pins 23-24 for start/stop signals. (Close---start, open---stop)

- The LOCAL/REMOTE select switch in the power supply is set to REMOTE.
- MOM/ALT select switch is set to ALT.

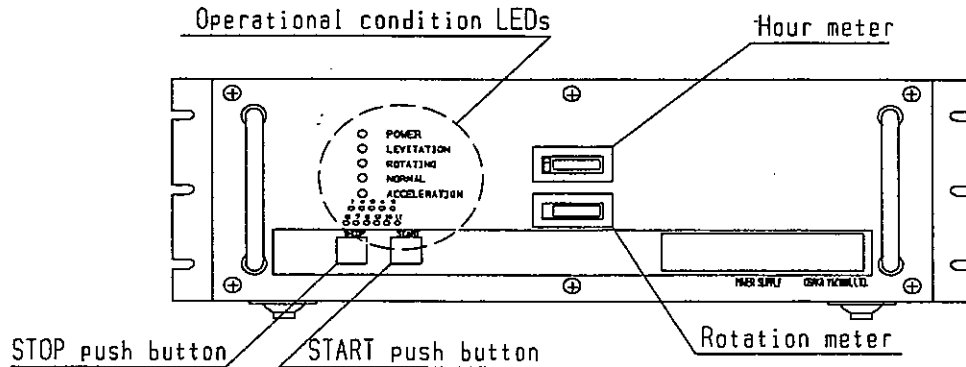
! WARNING : Prior to setting the switches, be sure to turn off the input power.

Before shipment the switches have been set to LOCAL.

6-2. Start and stop of the MS type CMP

1) Local operation

Pump's start and stop operations are performed through the START and STOP buttons on the front panel of the power supply. Confirm that the Local/Remote selection switch in the power supply is set to Local. On the power supply front panel, LEDs, an hour meter and a rotation meter are utilized.



- **POWER** ----- Lit when input power (AC200/220V) is supplied.
- **LEVITATING** ----- Lit when the rotor is levitated.
- **ROTATING** ----- Lit when the rotor is rotating.
- **NORMAL** ---- Lit when under normal operation (above 80% of rated rotation speed)
- **ACCELERATION** ---- Lit during acceleration.
- **1** ----- Magnetic Suspension Failure
- **2** ----- Heat Sink Over Heat
- **3** ----- Hall Sensor Failure
- **4** ----- not used
- **5** ----- Over Current
- **6** ----- C.S.B.
- **7** ----- Protection Signal Open
- **8** ----- Motor Over Heat
- **9** ----- Acceleration Time Over
- **10** --- Input Power Insufficient Voltage
- **11** --- Over Speed
- **Hour meter**---- Displays accumulated pump operation time.
It can be reset to 0 by the reset button of the hour meter.
- **Rotation meter** ---- Displays the rotor's rotation speed.

A. Input power ON

Operation Status	Front Panel Display	Functions
Power ON	<input type="radio"/> POWER <input checked="" type="radio"/> LEVITATING <input checked="" type="radio"/> ROTATING <input checked="" type="radio"/> NORMAL <input checked="" type="radio"/> ACCELERATION 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ●	" Power " will be lit The fan in the back of power supply will start rotating.

B. START : START button pushed

Under Acceleration	<input type="radio"/> POWER <input type="radio"/> LEVITATING <input type="radio"/> ROTATING <input checked="" type="radio"/> NORMAL <input type="radio"/> ACCELERATION 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ●	Rotor will be levitated and start acceleration. "Levitating," "Rotating" and "Acceleration" will be lit.
Under Normal Operation	<input type="radio"/> POWER <input type="radio"/> LEVITATING <input type="radio"/> ROTATING <input type="radio"/> NORMAL <input checked="" type="radio"/> ACCELERATION 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ●	"Acceleration" will be turned off and "Normal" will be lit. This shows that the pump is under the rated normal operation

C. STOP : STOP button pushed

Under Deceleration	<input type="radio"/> POWER <input type="radio"/> LEVITATING <input type="radio"/> ROTATING <input checked="" type="radio"/> NORMAL <input checked="" type="radio"/> ACCELERATION 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ●	"Normal" and "Acceleration" will be turned off and the pump will start decelerating by the brake.
Stop	<input type="radio"/> POWER <input checked="" type="radio"/> LEVITATING <input checked="" type="radio"/> ROTATING <input checked="" type="radio"/> NORMAL <input checked="" type="radio"/> ACCELERATION 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ●	When the rotor's speed is reduced to a few rps. "Levitating" and "Rotating" will be turned off.

Power OFF	<ul style="list-style-type: none"> ● POWER ● LEVITATING ● ROTATING ● NORMAL ● ACCELERATION 	All LED will be turned off.
-----------	---	-----------------------------

Under local operation, output signals from the "REMOTE" connector at the rear of the power supply are still the same as those in remote operation.

! WARNING : Do NOT remove the input power until the rotor of the pump stops completely. (Only "Power" will be lit.)

3) Remote operation

Start of the molecular pump is initiated by momentarily closing the start signal fed between pins 1 - 2 of the "REMOTE" connector at the rear of the power supply. Another way is to close the start/stop signal fed between pins 23- 24.

Confirm that the Local / Remote selection switch in the power supply is set to Remote.

In remote operation, too, the front panel LEDs will function in the same way as in the local operation.

The output signals from the "REMOTE" connector are as follows.

A. Input power ON

Operation Status	Output Signals from "REMOTE" connector	Functions	
Power ON		Acc-----Open Normal-----Open Failure-----Open Levitating---Open Rotating-----Open	The cooling fan will start rotating. All output signals except "Failure" are currently open.

B. Start : Start signal Momentary Close (pins between 1-2) or Start/Stop signal Close (pins between 23-24)

Under Acceleration		Acc-----Close Normal-----Open Failure-----Open Levitating---Close Rotating-----Close	Rotor will be levitated and start rotating. "Acceleration," "Rotating" and "Levitating" signals will become close.
--------------------	--	--	---

Under Normal Operation		7	Acc-----Open	"Acceleration" signal will open and "Normal" signal will become close.
		8		
		9	Normal-----Close	
		15		
		10	Failure-----Open	
		11		
	12	Levitating---Close		
	13			
	14	Rotating----Close		
	20			

C. STOP : Stop signal Momentary Close (pins between 3-4) or Start/Stop signal Open (pins Between 23-24)

Under Deceleration		7	Acc-----Open	"Normal" and "Acceleration" signals will open and deceleration will start with the brake.
		8		
		9	Normal-----Open	
		15		
		10	Failure-----Open	
		11		
	12	Levitating---Close		
	13			
	14	Rotating----Close		
	20			
Stop		7	Acc-----Open	When rotor rotation speed is reduced to a few rps, "Levitating" and "Rotating" signals will open and all signals except "Failure" become open.
		8		
		9	Normal-----Open	
		15		
		10	Failure-----Open	
		11		
	12	Levitating---Open		
	13			
	14	Rotating----Open		
	20			

! CAUTION : When operating in remote operation, use either the Start, Stop signals fed to pins 1-2 and 3-4 of the "Remote" connector, or Start/Stop signals connected to pins 23-24.

Do NOT operate using both.

! CAUTION : Do NOT remove the input power until the pump stops completely.

(Only "Power" will be lit.)

6-3. Start and stop of the MS type CMP during acceleration/deceleration

The pump can be stopped during acceleration or can be re-accelerated during the stop. However, leave at least 5 seconds between each start and stop operation.

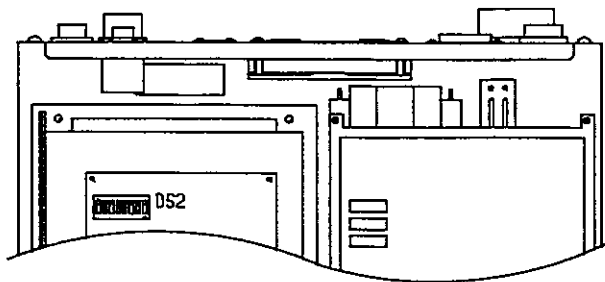
6-4. The variable rotation speed feature of the MS type CMP

The MS type CMP can vary its rotation speed during the operation by the signals fed through the "REMOTE" connector of the rear side of the power supply.

When using this feature, follow the procedures in below.

- 1) Turn the input power OFF.
- 2) Set the switch DS2 - 1 in the power supply to ON. This will enable the variable rotation speed feature.

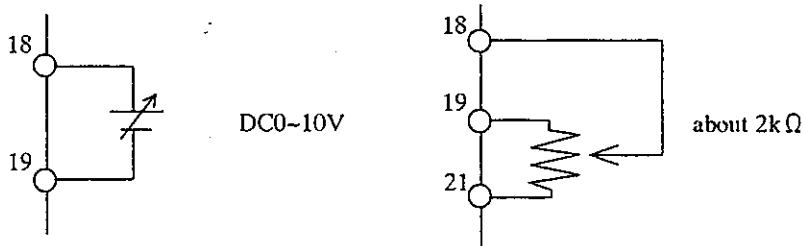
At the time of shipping, the setting is OFF.



! WARNING : DO NOT attempt to follow this procedure when the power is ON.

- 3) There are the following two methods to alter the rotation speed of the MS type CMP during its operation.

- A. Supply DC10V to pins between 18-19 of the "REMOTE" connector.
- B. Connect a 2k Ω variable resistor between pins 18-19-21 of the "REMOTE" connector.

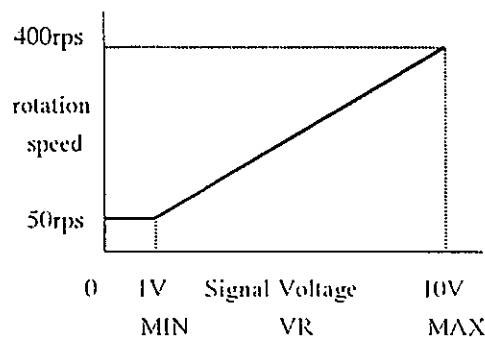
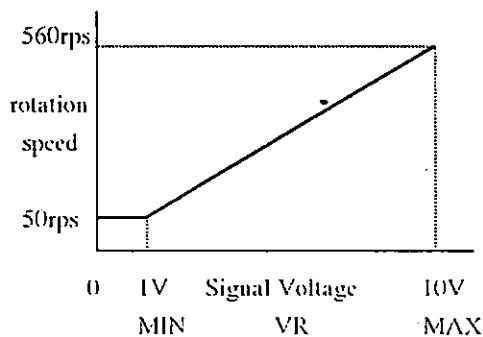


! CAUTION : Do NOT attempt both A and B methods at the same time.

- 4) The relationship between the rotation speed and the input signals are shown in Figure 4.

For TG730M/TG733M/TG1130M/TG1133M/
TG730EM/TG733EM/TG1130EM/TG1133EM

For TG2000M/TG2003M



For TG2810EM/TG2813EM/TG3210EM/TG3213EM/TG3410EM/TG3413EM

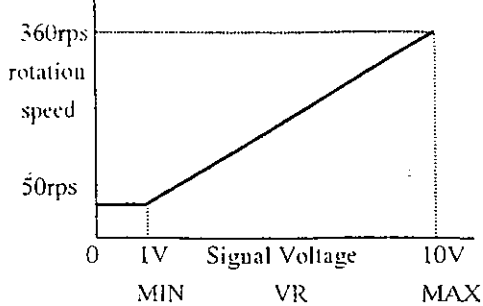


Figure 4. The rotation speed vs. the input signals

! CAUTION : DO NOT repeat altering the rotation speed in a short period of time during the operation. Leave at least 30 minutes between the alterations. Or, the pump may indicate an error and may stop.

6-5. Serial interface

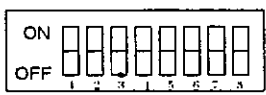
You can perform pump's start and stop operation and confirm the pump's status in detail with serial interface. Set the LOCAL/REMOTE select switch in the power supply to Remote.

Serial interface specifications

CONTENTS		SPECIFICATIONS		
1	System	RS232C *		
2	Format	Command format	(1) Command transfer character with ASCII Code (2) Transfer output with ASCII Code (3) No distinction between capital letter and small letter. (4) Delimiter:CR(0Dh) command [=parameter]CR Output Success: OK Unknown command: UNKNOWN COMMAND XXXXXX Illegal parameter: ILLEGAL PARAMETER XXXXXX	
		Communication format	(1) 8 bit data, Non-parity, 1 stop bit (2) No protocol method (3) No handshake	
3	Switch on the PCB	Transfer rate	1200 / 2400 / 4800 / 9600 (bps)	
		Echo back	Yes / No	
4	Command	Command	Content	Output
		START	Start	
		STOP	Stop	
		RESET	Reset failure	
		ID?	Model	ex. ID=BLD400S
		VERSION?	Version	ex. VER=1.00
STATUS?	Current condition	STATUS= STANDBY(MS:LEVITATING) STATUS= ACC(MS:LEVITATING)		

*RS232C interface but without "safe to touch" status. is not SELV

CONTENTS		SPECIFICATIONS	
↓ Command	Command	Content	Output
			STATUS= NORMAL(MS:LEVITATING) STATUS= BRAKE(MS:LEVITATING) STATUS= FAILURE:OVER CURRENT STATUS= FAILURE:OVER LOAD STATUS= FAILURE:OVER MOH STATUS= FAILURE:OVER DOH STATUS= FAILURE:FAN STATUS= FAILURELOW VOLTAGE STATUS= FAILURE:HALL SENSOR STATUS= FAILURE:OVER SPEED STATUS= FAILURE:EEX STATUS= FAILURE:MS
	SPEED?	Current rotation speed	ex. S=5000
	HOUR?	Current operation hours	ex. H=12345
	CURRENT?	Current output of Current	ex. I=10.5
	SET SPEED=XXXXX	Set rotation speed	Unit is rpm
	SETTING?	Current setting	SETTING ACC CURRENT=XX.X ACC TIME=X ACCTONORMAL=XX.X BRAKE CURRENT=XX.X SPEED=XXXXX END
	STORE	Store current parameter to EEPROM.	

No.	Setting	FUNCTION																													
5	DS2 * Dip switch	 <p>Set switch before turning on power.</p>																													
		<table border="1"> <thead> <tr> <th>SW No.</th> <th>Function</th> <th colspan="2">Setting</th> </tr> <tr> <th></th> <th></th> <th>OFF</th> <th>ON</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Variable rotation</td> <td>for serial interface</td> <td>for remote connector</td> </tr> <tr> <td>2</td> <td>DO NOT touch</td> <td>Always stay OFF.</td> <td></td> </tr> <tr> <td>3</td> <td>Echo back</td> <td>No</td> <td>Yes</td> </tr> <tr> <td>4</td> <td>Start/Stop Signal</td> <td>Cancel</td> <td>Effect</td> </tr> <tr> <td>5</td> <td>DO NOT touch</td> <td>Always stay OFF</td> <td></td> </tr> </tbody> </table>	SW No.	Function	Setting				OFF	ON	1	Variable rotation	for serial interface	for remote connector	2	DO NOT touch	Always stay OFF.		3	Echo back	No	Yes	4	Start/Stop Signal	Cancel	Effect	5	DO NOT touch	Always stay OFF		
SW No.	Function	Setting																													
		OFF	ON																												
1	Variable rotation	for serial interface	for remote connector																												
2	DO NOT touch	Always stay OFF.																													
3	Echo back	No	Yes																												
4	Start/Stop Signal	Cancel	Effect																												
5	DO NOT touch	Always stay OFF																													

No.	Setting	FUNCTION																			
6	DO NOT touch	Always stay OFF																			
7, 8	Baud rate	<table border="1"> <thead> <tr> <th colspan="2">Switch No.</th> <th>Bps</th> </tr> <tr> <th>7</th> <th>8</th> <th></th> </tr> </thead> <tbody> <tr> <td>OFF</td> <td>OFF</td> <td>1200</td> </tr> <tr> <td>ON</td> <td>OFF</td> <td>2400</td> </tr> <tr> <td>OFF</td> <td>ON</td> <td>4800</td> </tr> <tr> <td>ON</td> <td>ON</td> <td>9600</td> </tr> </tbody> </table>		Switch No.		Bps	7	8		OFF	OFF	1200	ON	OFF	2400	OFF	ON	4800	ON	ON	9600
Switch No.		Bps																			
7	8																				
OFF	OFF	1200																			
ON	OFF	2400																			
OFF	ON	4800																			
ON	ON	9600																			

* The switches are set to off before shipping at factory.
 The location of DS2 is shown at 6-4 (p20).
 This interface doesn't have handshaker at all and also doesn't output signal of handshake.
 Please short pin 4 - pin 5 and pin 6 - pin 8 - pin 20 if your system has handshake.

7. Baking

Upon performing a baking of the MS type CMP, mount a baking heater on top of the pump casing as shown in Figure 5. Keep the baking temperature below 120°C.

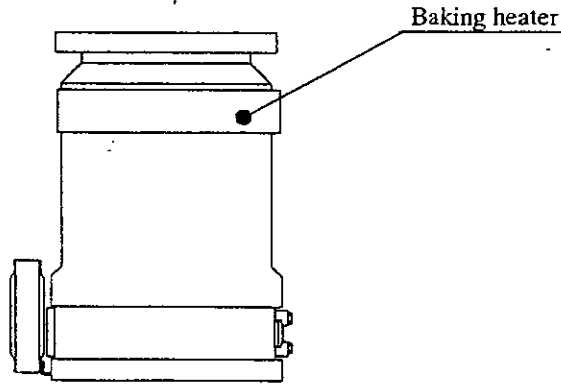


Figure 5. Mounting position of the baking heater.

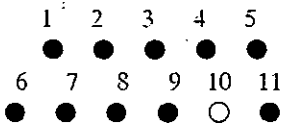
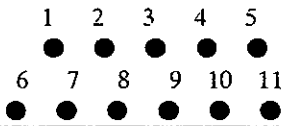
! WARNING : A wrong mounting position or an excessive baking temperature may result in a pump failure.

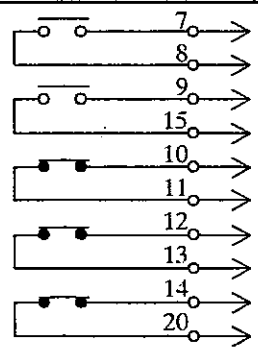
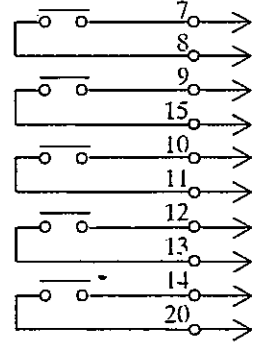
8. Protection Feature

8-1. Power failure

If a power failure occurs during operation of the MS type CMP, the speed of the pump will be reduced with the rotor still levitating. When the rotation speed is reduced to ~30% of its normal rated speed, the rotor will touchdown to the protection bearings. If the power is recovered on the way, the rotor will still continue reducing its speed.

When a power failure occurs during the operation, the front panel display and the output signals from the "REMOTE" connector at the rear should look like the following

Operation Status	Front Panel Display	Functions
Immediately after a power failure	<ul style="list-style-type: none"> ● POWER ○ LEVITATING ○ ROTATING ● NORMAL ● ACCELERATION 	The rotor will decrease its speed with the rotor still levitating. LED 10 will be lit indicating a power failure.
About 3 -10 minutes after the power failure	<ul style="list-style-type: none"> ● POWER ● LEVITATING ● ROTATING ● NORMAL ● ACCELERATION 	The rotor will touchdown to the protection bearings and will continue reducing its speed. All LEDs will be turned off.

Operation Status	Output signals from the "REMOTE" connector	Functions	
Immediately after a power failure		<p>Acc-----Open</p> <p>Normal-----Open</p> <p>Failure-----Close</p> <p>Levitating---Close</p> <p>Rotating-----Close</p>	The rotor will decrease its speed with the rotor still levitated. "Failure" signal will close.
About 3-10 minutes after the power failure		<p>Acc-----Open</p> <p>Normal-----Open</p> <p>Failure-----Open</p> <p>Levitating---Open</p> <p>Rotating-----Open</p>	The rotor will touchdown to the protection bearings and will continue reducing its speed. All signals will open

8-2. Protection circuitry

If an error occurs on the MS type CMP or the power supply, the error indications will be displayed on the front panel and the pump will stop.

The error indications (LED1~11) on the front panel and the output signals from the "REMOTE" connector at the rear panel are shown below.

Front Panel Display	Error	Description
1 2 3 4 5 ○ ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ●	Magnetic suspension failure	Lit when an error occurs on the magnetic suspension. Rotor will touchdown to the protection bearings.
1 2 3 4 5 ● ○ ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ●	Heat sink over heat	Lit when the heat sink in the power supply is over heated and the thermal protector is triggered.
1 2 3 4 5 ● ● ○ ● ● 6 7 8 9 10 11 ● ● ● ● ● ●	Hall sensor failure	Lit when the rotation sensor in the pump is in error.
1 2 3 4 5 ● ● ● ● ○ 6 7 8 9 10 11 ● ● ● ● ● ●	Over current	Lit when an excessive current flows in the power supply.
1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ○ ● ● ● ● ●	C.S.B.	Lit when the pump has 5 times of touchdown. The protection bearings need to be replaced.
1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ○ ● ● ● ●	Protection signal open	Lit when the signal connected to the pins between 5-6 of the "REMOTE" connector opens.
1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ○ ● ● ●	Motor over heat	Lit when the motor in the pump is over heated and the thermal protector is triggered.
1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ○ ● ●	Acceleration time over	Lit when "Normal" does not come ON after a set time at the time of startup, or when once "Normal" was ON but the pump went back to "Acceleration" and could not return to "Normal" again after a set time.
1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ○ ●	Insufficient input voltage	Lit when the input voltage to the power supply is dropped to a value below the specified voltage. (about 175 V)
1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ○	Over speed	Lit when the rotor speed exceeds 105% of its rated normal speed.

Of the above specified errors, for the hall sensor failure, the heat sink over heat, the motor over heat and the over current, the speed reduction takes place without the brake function. The error display has a self-hold feature.

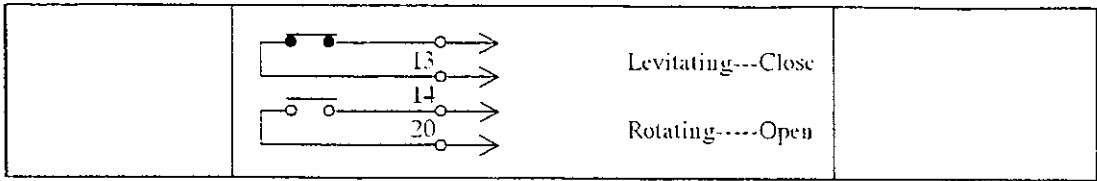
The output signals from the "REMOTE" connector are as follows.

1) Magnetic suspension failure

Operation Status	Output signals from the "REMOTE" connector	Functions	
An error takes place		<p>Acc-----Open</p> <p>Normal-----Open</p> <p>Failure-----Close</p> <p>Levitating---Open</p> <p>Rotating----Close</p>	The rotor will touchdown to the protection bearings and "Levitating" signal will open. "Failure" signal will close.
Pump stop		<p>Acc-----Open</p> <p>Normal-----Open</p> <p>Failure-----Close</p> <p>Levitating---Open</p> <p>Rotating----Open</p>	"Failure" signal is held at close with the self-hold. When the rotor speed is decreased to a few rps, "Rotating" signal will be out.

2) Other errors

Operation Status	Output signals from the "REMOTE" connector	Functions	
An error takes place		<p>Acc-----Open</p> <p>Normal-----Open</p> <p>Failure-----Close</p> <p>Levitating---Close</p> <p>Rotating----Close</p>	"Failure" signal will open and the rotor will start to decelerate.
Pump stop		<p>Acc-----Open</p> <p>Normal-----Open</p> <p>Failure-----Close</p> <p>Levitating---Close</p>	"Failure" signal is held at open with the self-hold. The rotor will stop at its levitated position, and so "Levitating" signal remains closed.



8-3. Resetting the error display

For the local operation, reset is performed by pressing the STOP button on the front panel of the power supply. For the remote operation, reset is performed by momentarily closing the Stop signal between pins 3-4 of the "REMOTE" connector at the rear of the power supply, or by opening the Start/Stop signal connected to the pins 23-24 of the "REMOTE" connector.

If the error still cannot be reset after these operations, it indicates that the error condition still remains.

9. Troubleshooting

If the pump stops due to an error, follow the procedures below.

! WARNING : When performing a power supply check, wait at least 5 minutes after removing the input power before the work.

Error LED	Error description	Possible cause	Action
LED1	Magnetic suspension failure	- Magnetic suspension circuit error - Position sensor error	- Contact OSAKA VACUUM, LTD.
LED2	Heat sink over heat	- Repeated pump start/stop - Surrounding temperature of the power supply is high. - The fan at the rear of the power supply is in failure.	- Leave a longer interval - Cool off the surrounding temperature to below 40 - Replace the fan.
LED3	Hall sensor failure	- Rotation sensor failure	- Contact OSAKA VACUUM, LTD.
LED4	Not used		
LED5	Over current	- Motor driving circuit failure	- Contact OSAKA VACUUM, LTD.
LED6	C.S.B.	- Pump has 5 times of touchdown.	- Protection bearings need to be replaced. Contact OSAKA VACUUM, LTD.
LED7	Protection signal open	- The signal connected to pins 5-6 of the "REMOTE" connector at the rear of the power supply opened. - Fan connector or Fan cable is disconnected to the "FAN" at the rear of the power supply.	- Check the signal I/O - Connect the Fan connector (for water cooling pump) or the Fan cable (for air cooling pump) at the rear of the power supply.

LED8	Motor over heat	<ul style="list-style-type: none"> - Repeated pump start/stop. - Repeated pump speed alterations. 	<ul style="list-style-type: none"> - Leave some intervals between Start/Stop. - Leave some intervals between the speed alterations.
LED9	Acceleration time over	<ul style="list-style-type: none"> - The system has a leak. - Excessive gas flow - Foreline pressure of the molecular pump is high. 	<ul style="list-style-type: none"> - Check for the leak. - Lower the gas flow rate. - Check the pumping performance of the backing pump.
LED10	Insufficient input voltage	<ul style="list-style-type: none"> - Input voltage is below 175V. 	<ul style="list-style-type: none"> - Set the input voltage to a specified value. (AC200/220V ± 10%)
LED11	Over speed	<ul style="list-style-type: none"> - A power supply failure 	<ul style="list-style-type: none"> - Contact OSAKA VACUUM, LTD.
	"Power" does not come ON	<ul style="list-style-type: none"> - Input power is OFF. - Fuse is blown. - Input power cable has a wrong wiring. 	<ul style="list-style-type: none"> - Check the input power. - Replace the fuse at the rear of the power supply. - Check the input power cable wiring.
	The rotor does not rotate nor levitate.	<ul style="list-style-type: none"> - A wrong setting on the Local/Remote selection switch in the power supply. 	<ul style="list-style-type: none"> - Check the setting. Refer to the item 6-2.
	The rotation speed does not change after a variable rotation speed signal input.	<ul style="list-style-type: none"> - A wrong setting of the variable rotation speed switch in the power supply. 	<ul style="list-style-type: none"> - Check the setting. Refer to the item 6-4.

10. Maintenance

10-1. Protection bearings

If a magnetic suspension failure occurs, the rotor will be supported by the protection bearings, decrease its speed and finally stop. When LED6 (C.S.B.) is lit on the power supply front panel, the protection bearings need to be replaced. In case of using reactive gases or corrosive gases, before C.S.B. comes ON, overhaul the pump periodically.

! WARNING : If the protection bearings are damaged, it may lead to a serious accident such as rotor blades damage.

10-2. Reactive products

If too much reactive products are built up in the pump, the pump may not be able to start or may lead to a further serious failure. Overhaul the pump periodically.

! CAUTION : If the reactive products build-up are left in the pump, the corrosion on the pump will grow and the pump may not be able to be repaired any longer.

10-3. Parts deterioration

The cooling fan of the pump and the power supply deteriorate over the years. A periodical overhaul is recommended.

On the front panel of the power supply, an hour meter is utilized for the purpose of monitoring the pump's operation time as a reference to the overhaul time.

11. Storing the Pump and the Power Supply

When pump is stored for a long period of time, close the inlet, the foreline and the purge gas inlet.

To exchange all reactive or corrosive gases, purge the pump with a gas such as N₂.

Do NOT store the pump and the power supply at the following places.

- A place with a high temperature and high humidity
- A place with a reactive or corrosive gases
- A place with a water drops.
- A dusty place
- A place in a strong electric field or magnetic fields
- A radio active place
- A place with vibrations

STANDARD WARRANTY CONDITIONS

OSAKA VACUUM, LTD.

Article 1 Warranty

In delivery of the product indicated in the Delivery Specifications and/or the Instruction Manual ("Product"), we warrant that the Product is designed and manufactured in accordance with our regulation, standard or rule etc. with respect to design, purchase, manufacture and quality control under ISO9001 Standard or ISO9002 Standard as well as the specifications in the sales contract, and that there is no defect in design, materials or manufacture of the Product.

Article 2 Indemnification

In relation to the Product, in case any defect in design, materials or manufacture obviously attributable to us is found within the warranty period, one year from the delivery date of the Product (unless otherwise stipulated in written documents, and a notice of such defect is immediately given to us, we will, at our election, correct, repair or replace such defective part, or replace the whole Product without charge. The replacement is available only for standard Products, and no replacement may be allowed for any Custom-made Product.

Article 3 Exception

The warranty and relevant indemnification shall be applied only when the Product is properly installed or fixed, handled, used, stored and appropriately maintained by a user in accordance with the instructions stipulated in the Delivery Specifications, the Instruction Manual of the Product, other handling instructions of ours and/or the Related Technical Documents which we provide ("Related Technical Documents").

Unless otherwise stipulated in other written document, the warranty and relevant indemnification shall not be applied to the cases described below;

- (1) Any failure due to any usage of the Product not described in the Related Technical Documents of the Product, or any other irregular usage of the Product;
- (2) Deterioration of the Product due to corrosive gases, organic solvent, radioactive rays, electromagnetic field etc.;
- (3) Expendable parts and wearable parts such as lubricant etc.;
- (4) Any failure due to repair or reconstruction by any party other than us;
- (5) Repaired Products (the Standard Warranty Conditions for Repaired Products will apply to the repaired Products);
- (6) An insignificant deviation from the specifications in the sales contract which has no effect on performance or function of the Product;

(7) Any failure due to fire, flood, earthquake, lightning strike or any other event caused by force majeure.

Article 4 Scope of Indemnification

The scope of our indemnification shall be limited to the correction, repair or exchange of defective parts of the Product delivered, or replacement of the whole Product (in case of the standard Product only), and shall not include any compensation for the consequential damages and business losses including the following;

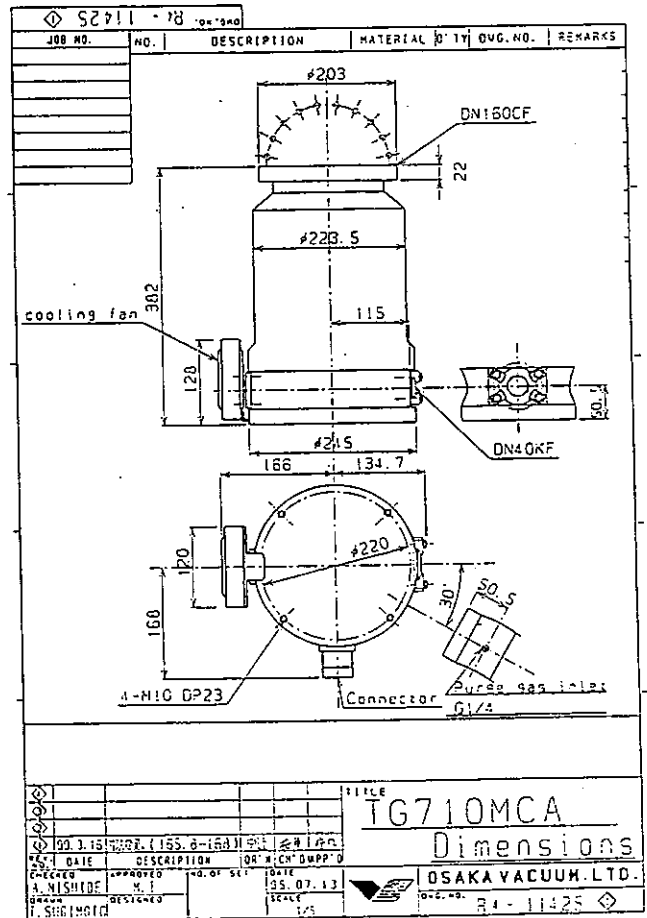
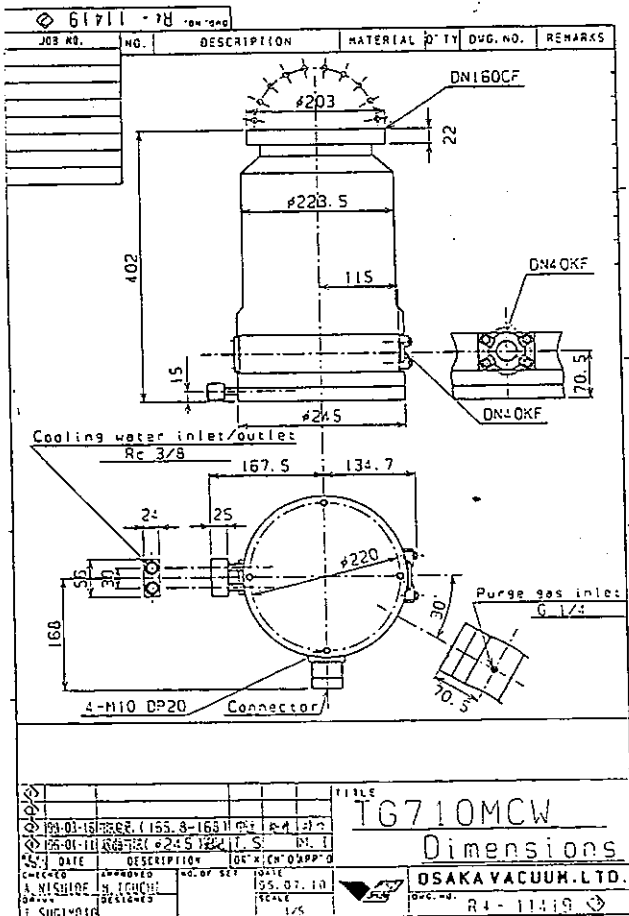
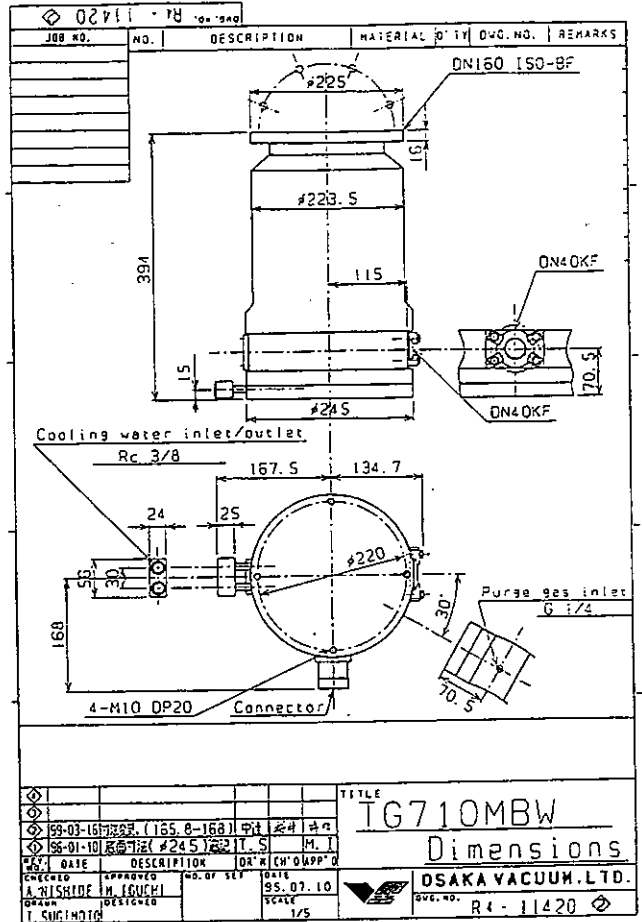
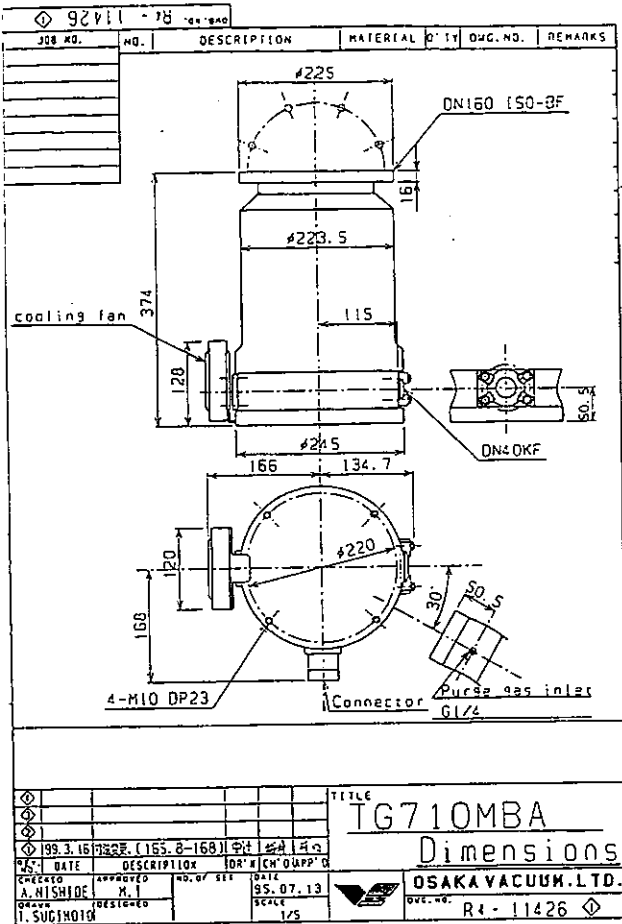
- (1) Costs and expenses accrued in connection with the removal of the failed Product from the equipment in which the Product has been installed; or
- (2) Costs and expenses accrued in connection with installment of the repaired Product or replacement to the equipment.

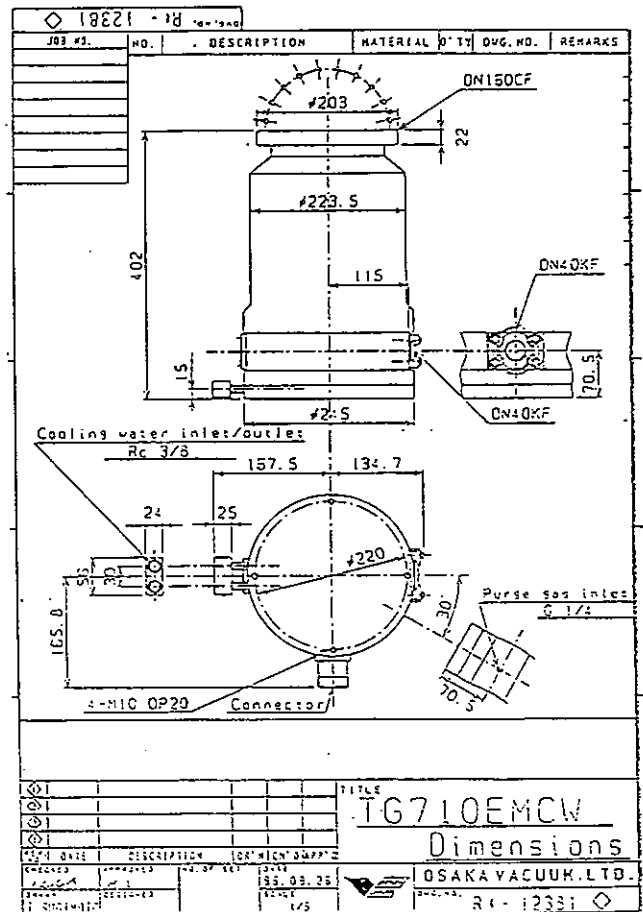
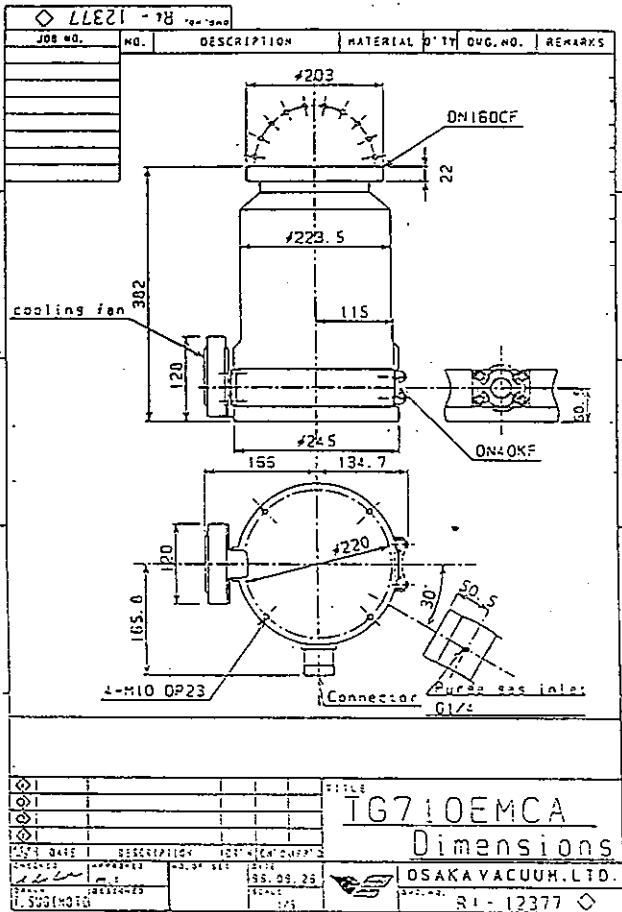
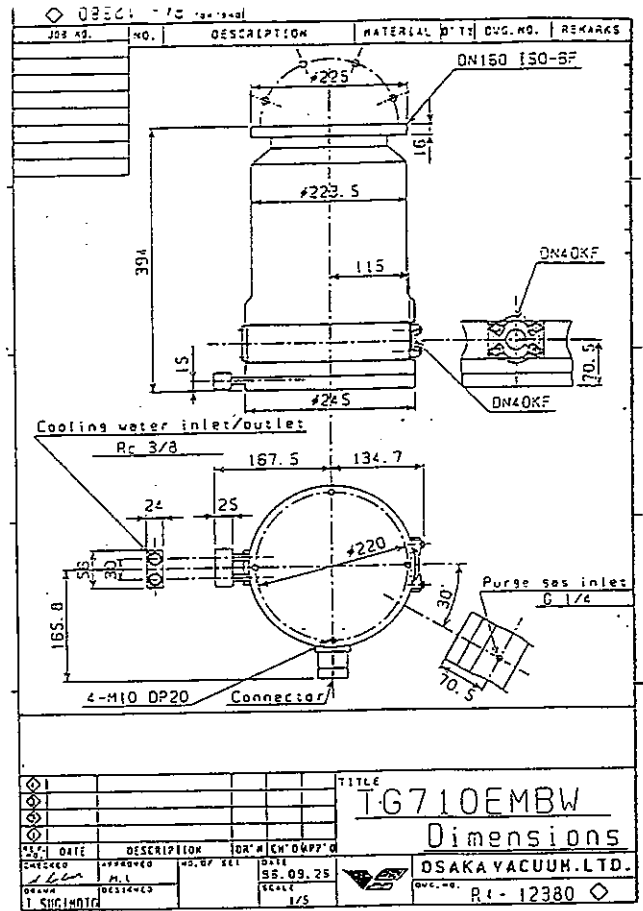
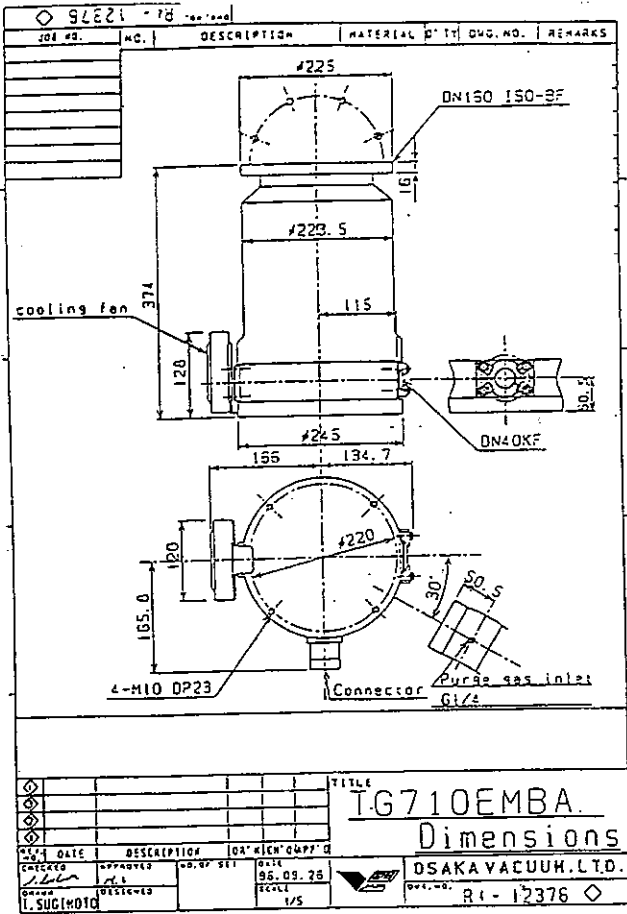
In addition, the total amount of the indemnification shall be limited to the contract price of the Product.

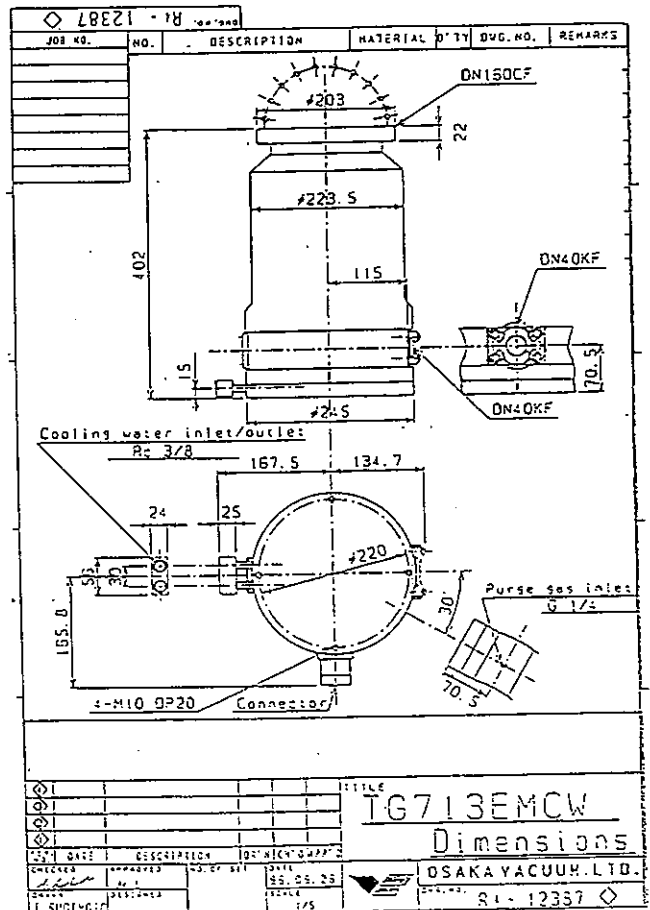
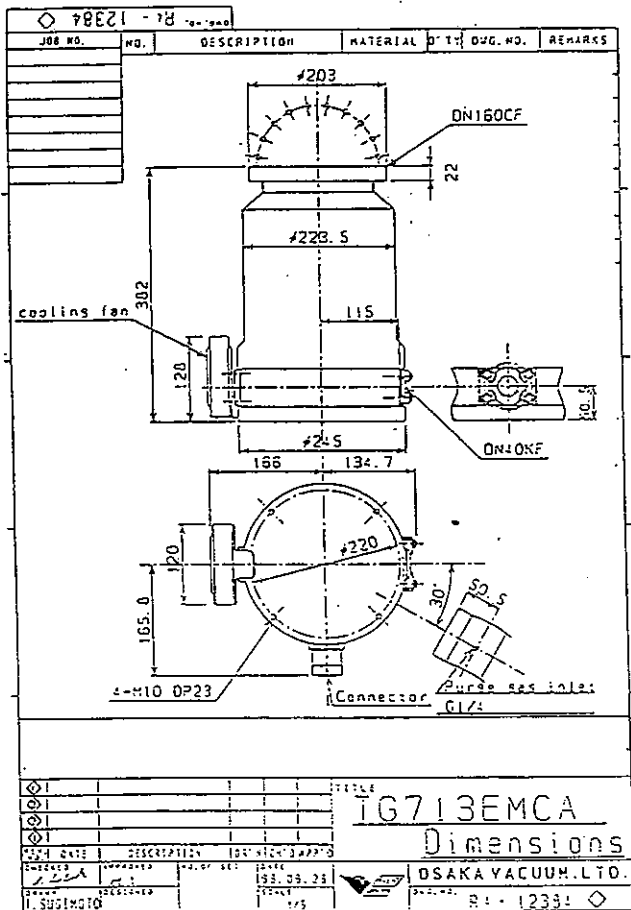
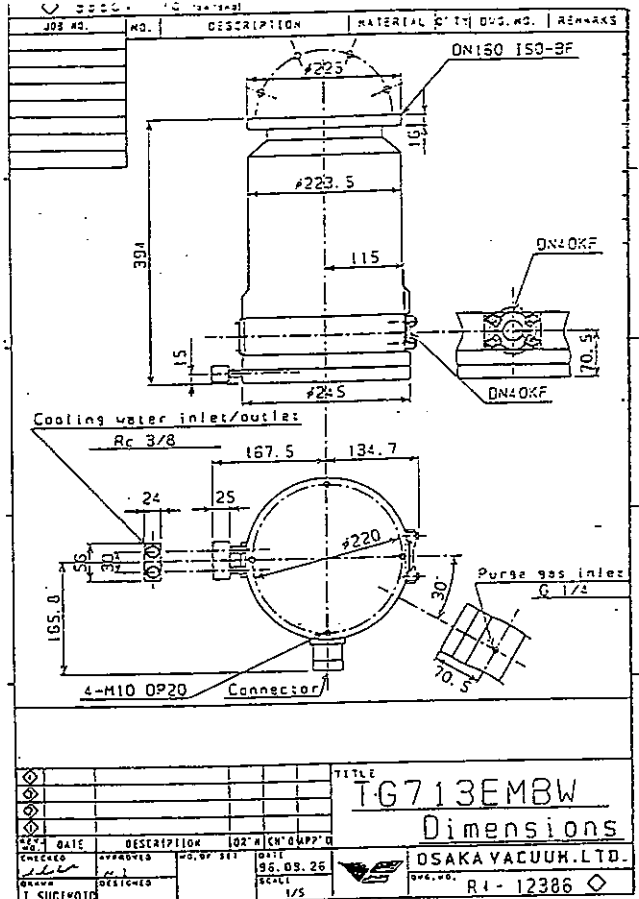
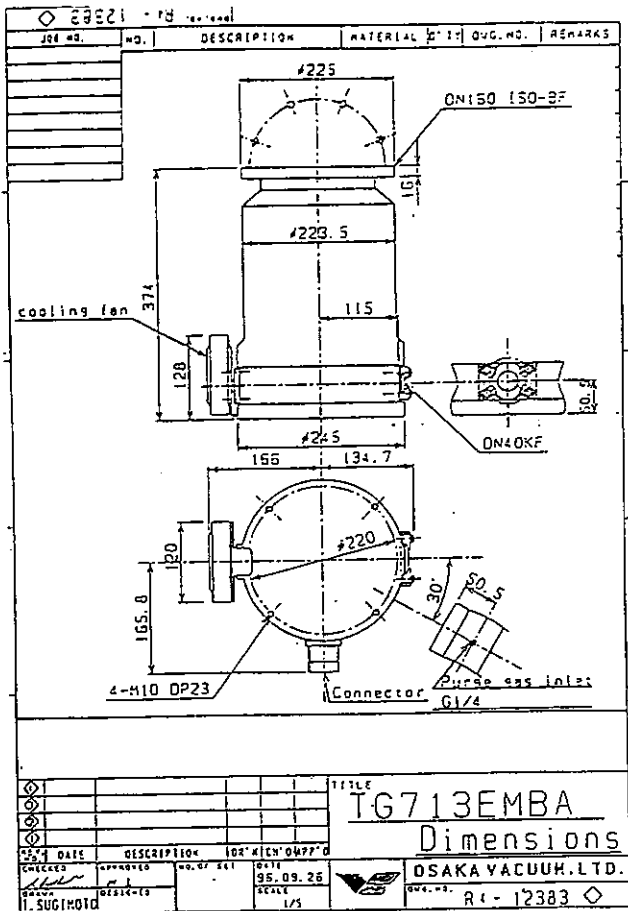
As for "Usage of the Product not described in the Related Technical Documents of the Product" stipulated in Article 3 of this Standard Warranty Conditions, such usage shall be included in the scope of indemnification under this Standard Warranty Conditions only when we agree in writing prior to the use of the Product.

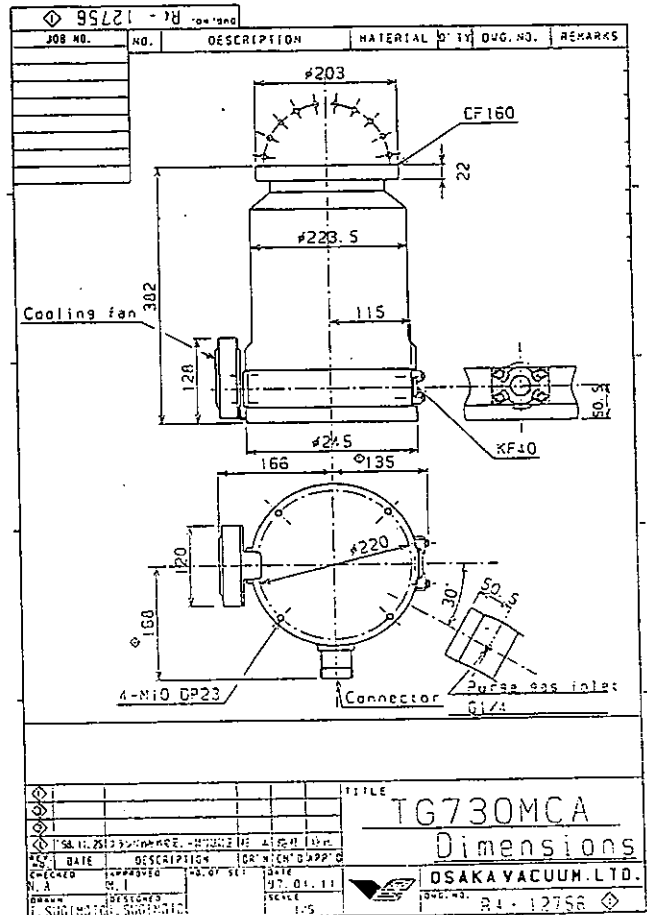
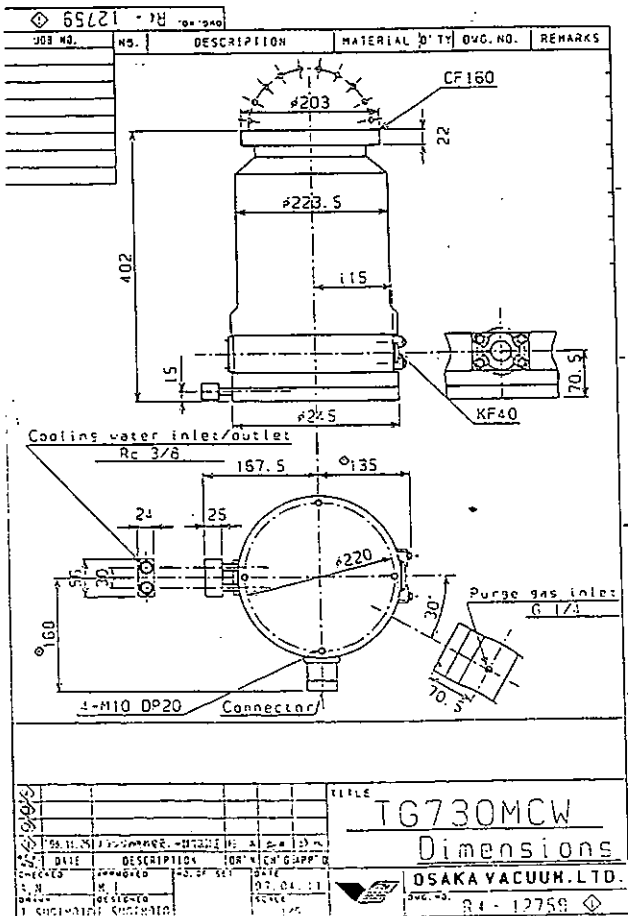
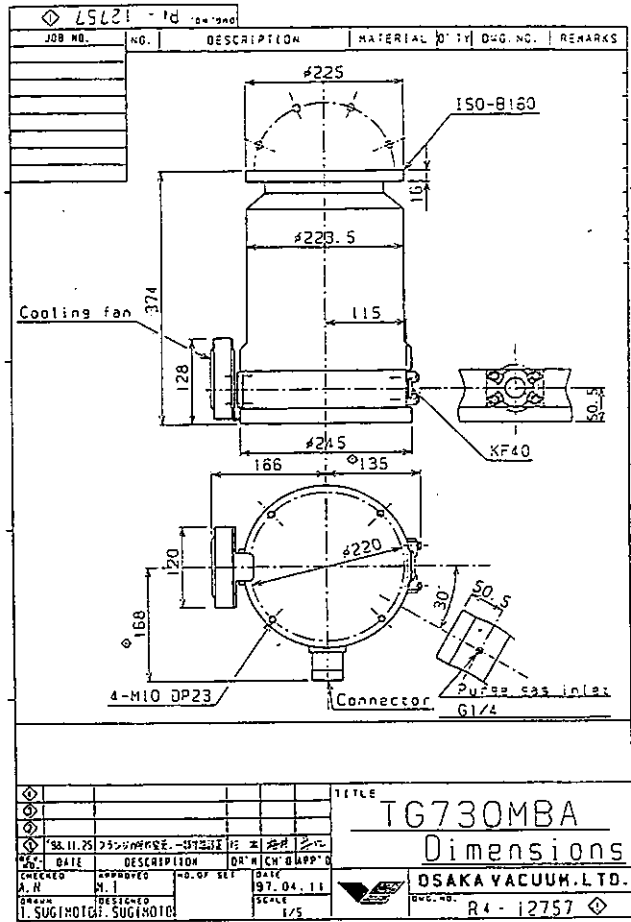
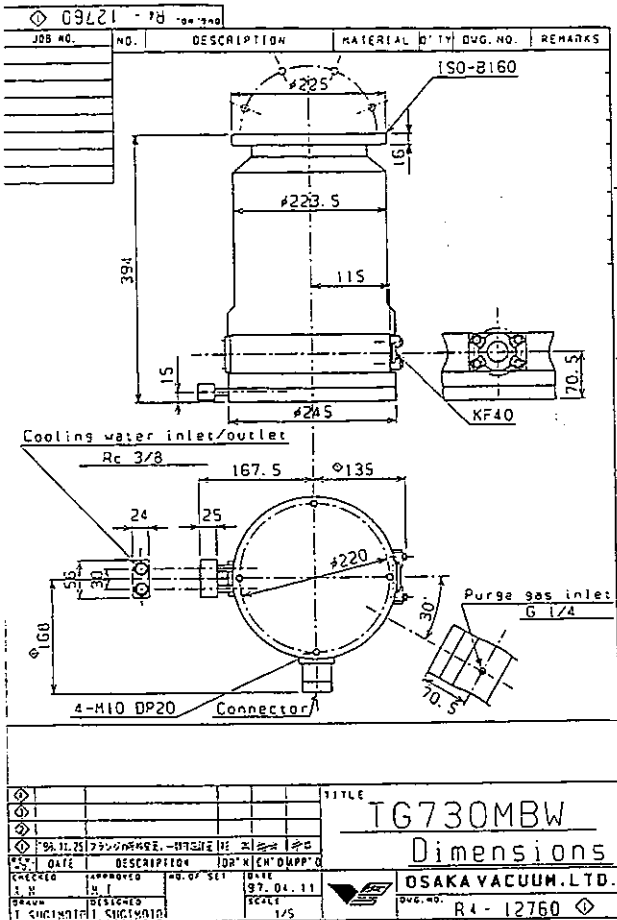
Specification.	Pump Model	TG710M/713M TG710EM/713EM TG730M/733M TG730EM/733EM	TG1110M/1113M TG1110EM/1113EM TG1130M/1133M TG1130EM/1133EM	TG2000M TG2003M	TG2810EM TG2813EM	TG3210EM TG3213EM	TG3410EM TG3413EM
Flange	inlet	VG150 ISO-160B CF160 KF40 700	VG200 ISO-200B CF200 KF40 1100	VG250 ISO-250B KF40 2000	VG250 ISO-250B KF40 2800	VG300 ISO-320B KF40 3200	VG350 KF40 3400
Pumping speed	for N2						
	L/s						
Rotation speed	rps	560		400		360	
Startup/Shutdown time	min	6/5		10/15		12/15	
Standard backing pump	m ³ /h	15		30		60	
Weight	kg	38		70		120	
Installation		in any position					
Permissible ambient temperature	°C	10~40					
Power Supply Model		TD711/1111-C		TD2001-C		TD3211-C	
Input voltage	ACV	200/220 over voltage category II					
frequency	Hz	50/60					
phase		Single					
power consumption	KVA	max.1.6				Max.1.8	
Weight	kg	23					
Permissible ambient temperature	°C	0~40		Pollution degree 2 or better			

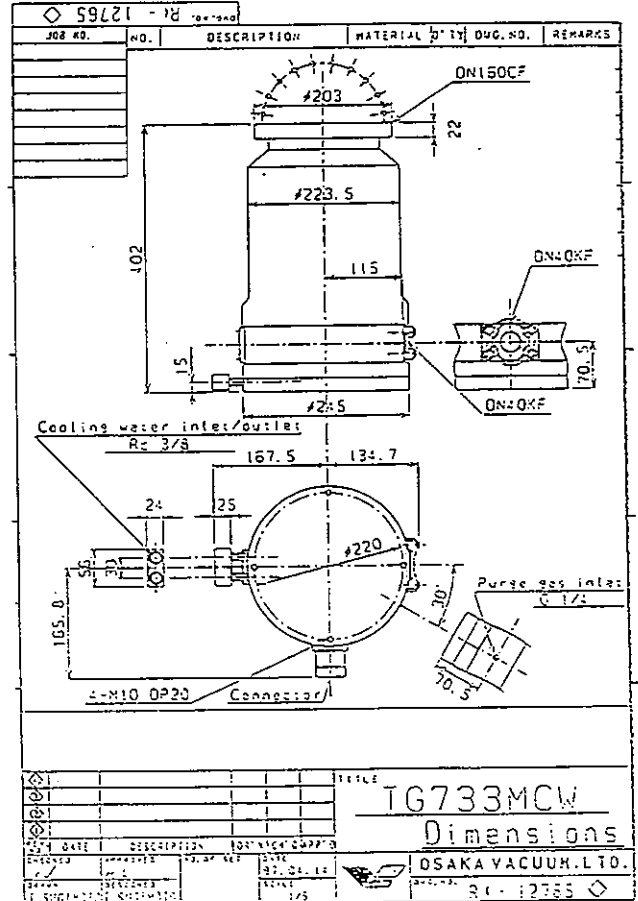
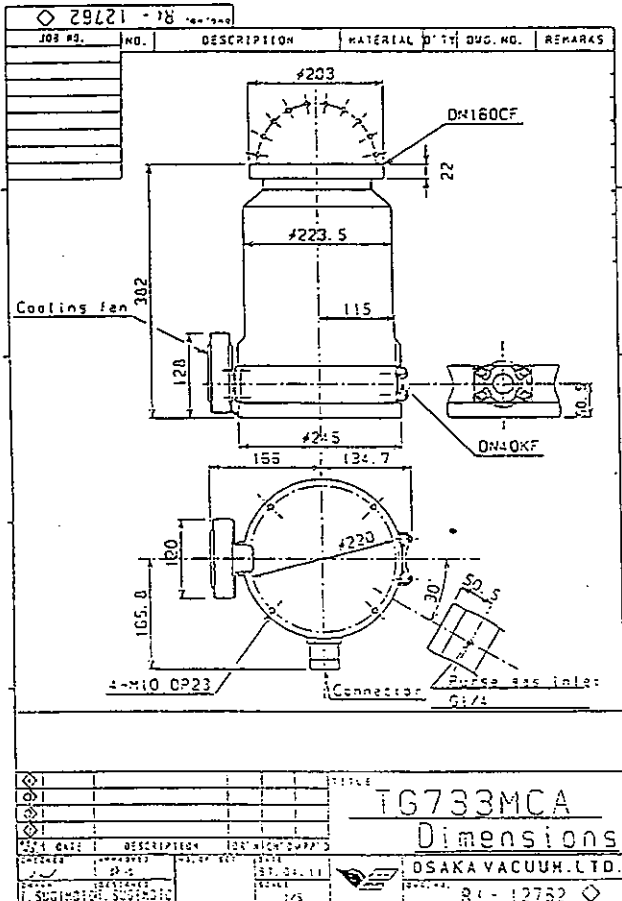
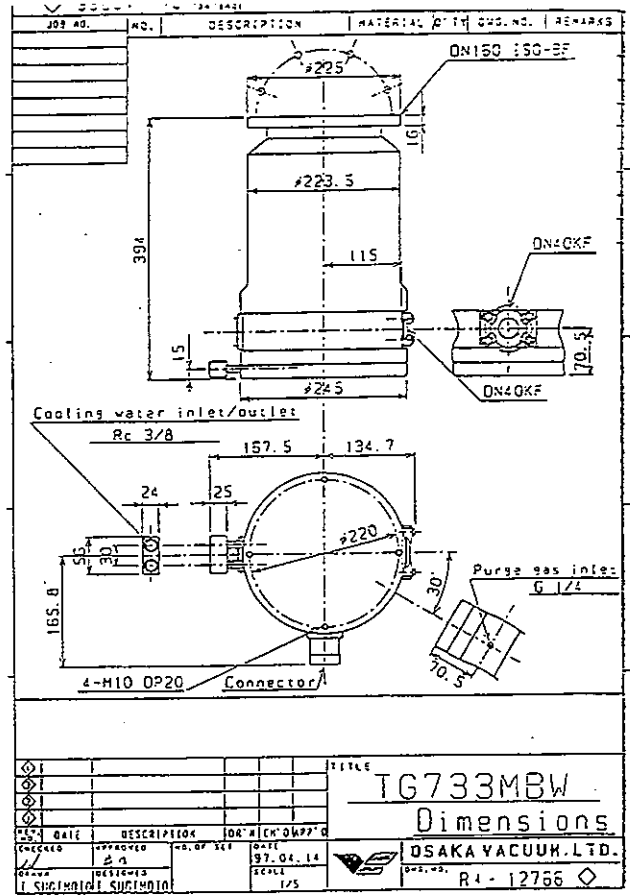
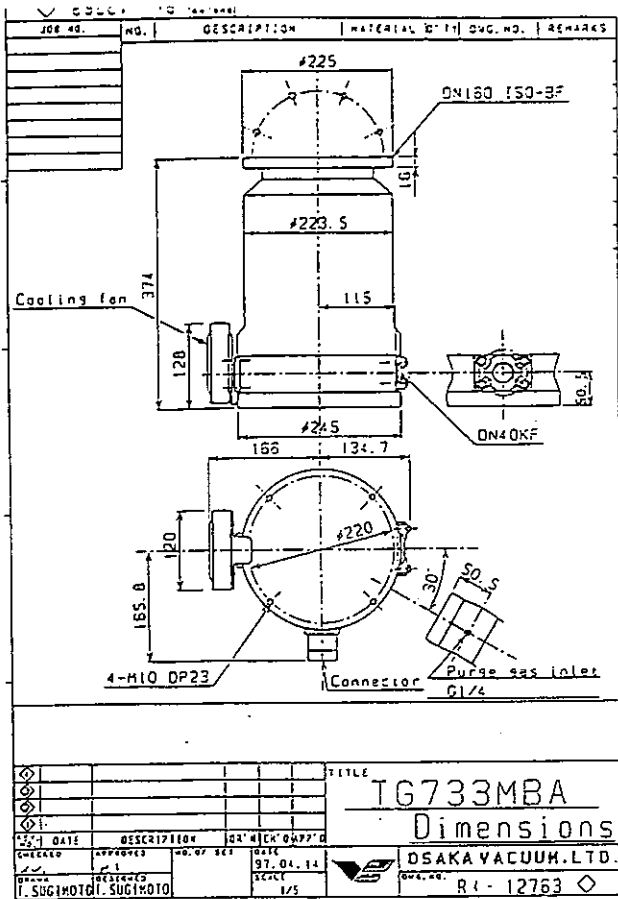
Isolated source (via transformers) : isolated from the standard supply system and isolated from earth/ground by at least basic insulation.
(A suitable supply transformer would be one of complying to IEC742.)

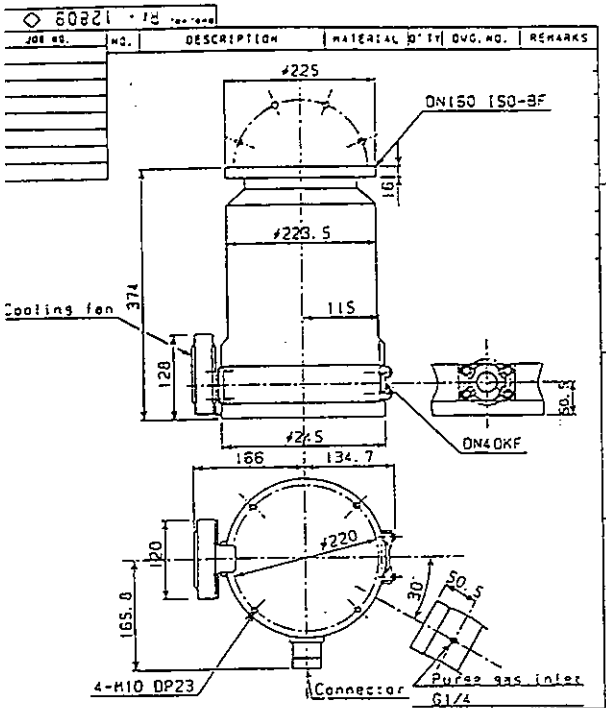




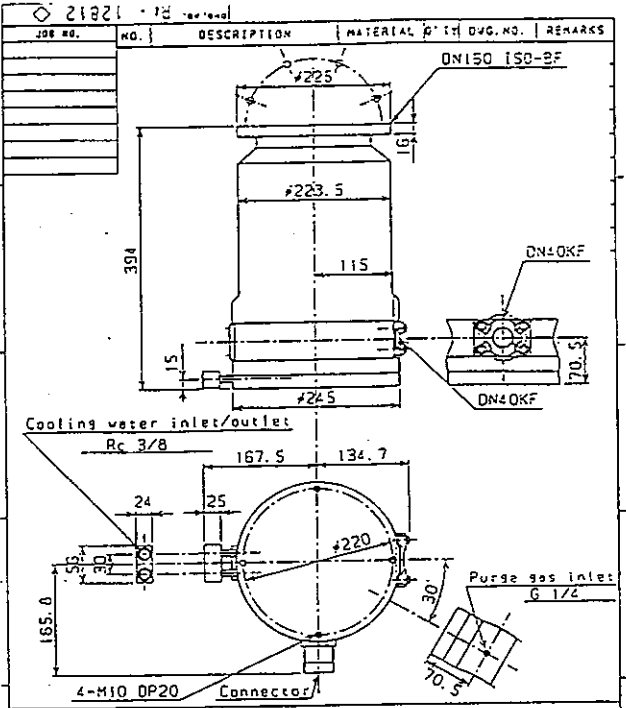




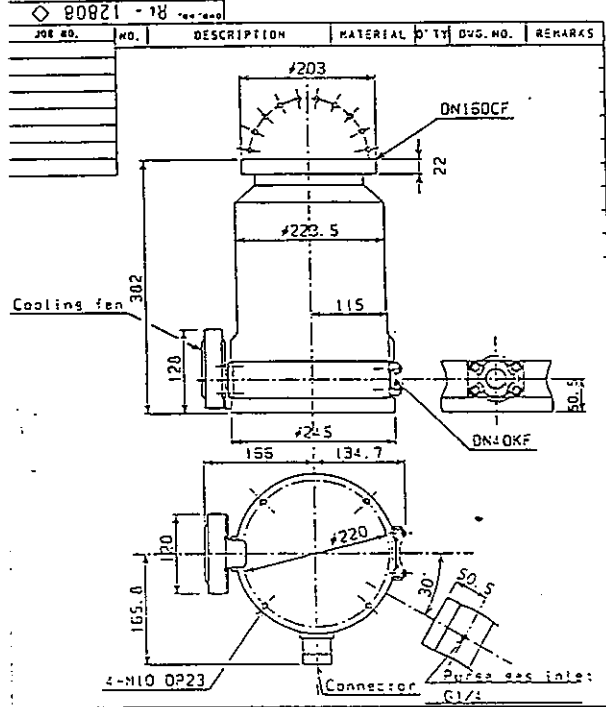




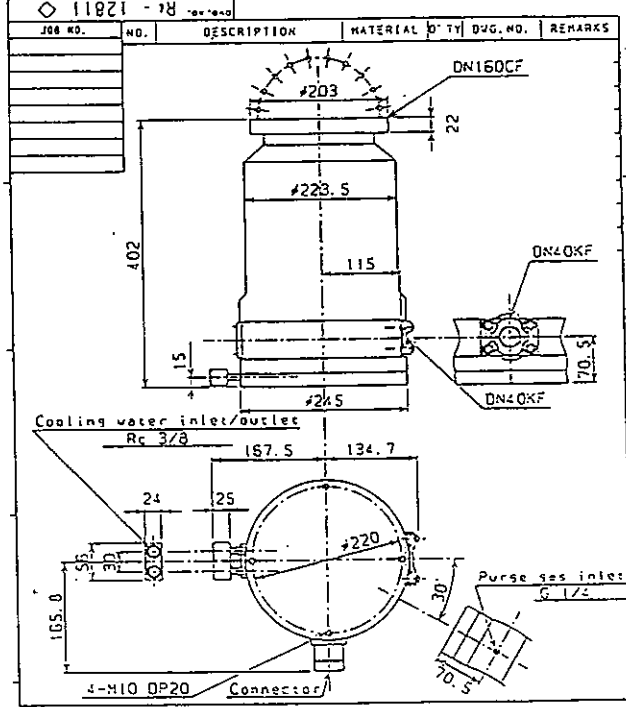
DATE		DESCRIPTION	DR.	CHK.	APP.	DATE	TITLE
Checked	Approved					97.04.29	TG730EMBA Dimensions
OSAKA VACUUM LTD. No. R1-12809							



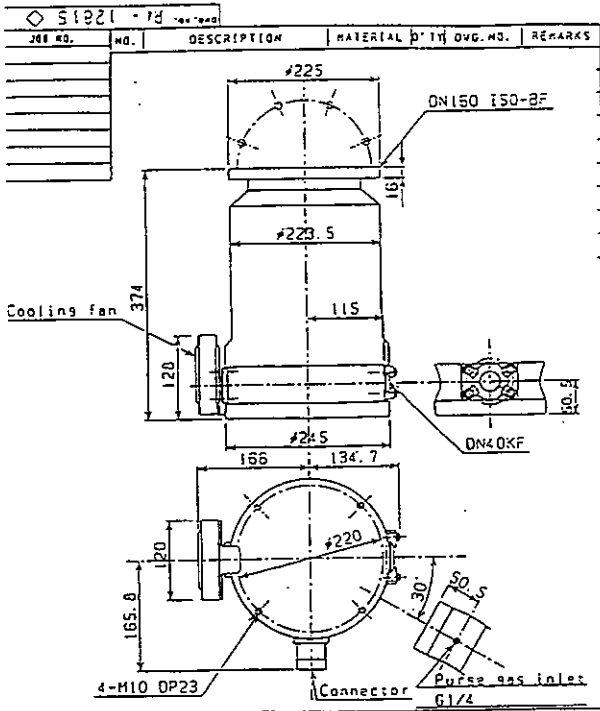
DATE		DESCRIPTION	DR.	CHK.	APP.	DATE	TITLE
Checked	Approved					97.04.29	TG730EMBW Dimensions
OSAKA VACUUM LTD. No. R1-12812							



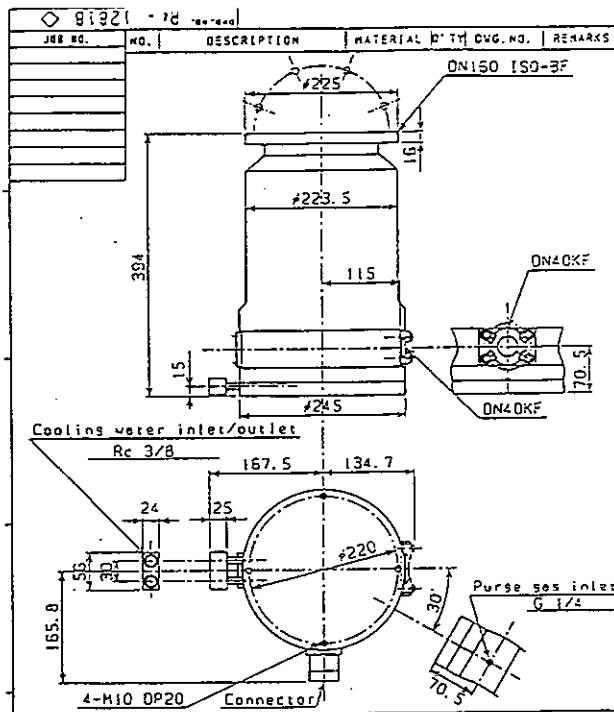
DATE		DESCRIPTION	DR.	CHK.	APP.	DATE	TITLE
Checked	Approved					97.04.29	TG730EMCA Dimensions
OSAKA VACUUM LTD. No. R1-12808							



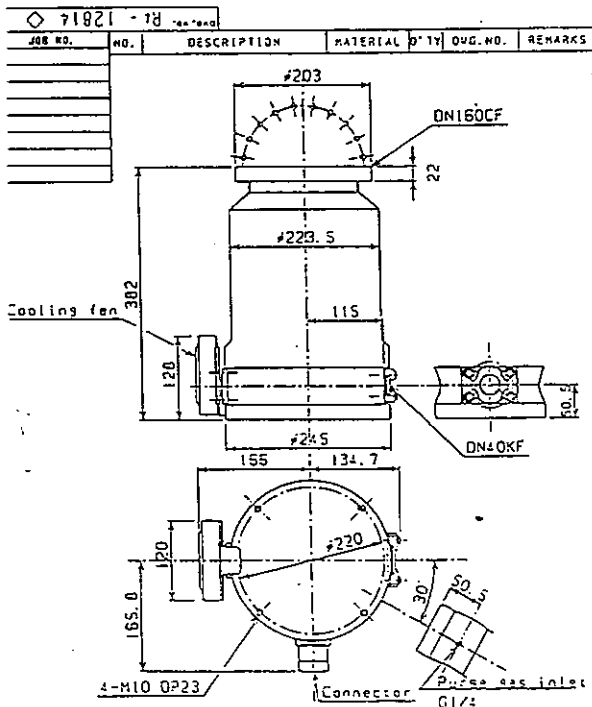
DATE		DESCRIPTION	DR.	CHK.	APP.	DATE	TITLE
Checked	Approved					97.04.29	TG730EMCW Dimensions
OSAKA VACUUM LTD. No. R1-12811							



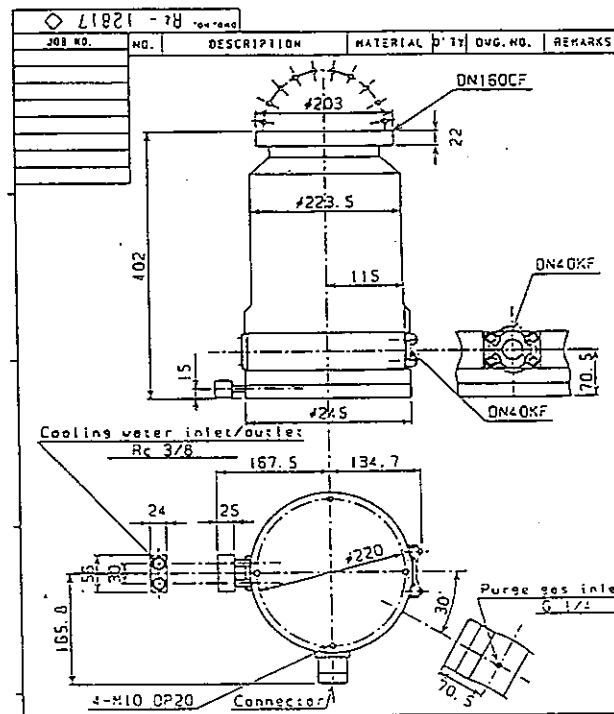
DATE		DESCRIPTION	DR.'S CH'G	APP'D	DATE	SCALE	TITLE
1/5	97.04.29	OSAKA VACUUM, LTD.					TG733EMBA Dimensions
CHECKED: [Signature] APPROVED: [Signature] NO. OF SET: 1/5 DRAWN: [Signature] DESIGNED: [Signature] SCALE: 1/5 T. SUGIMOTO SUGIMOTO							DSAKA VACUUM, LTD. R1-12815



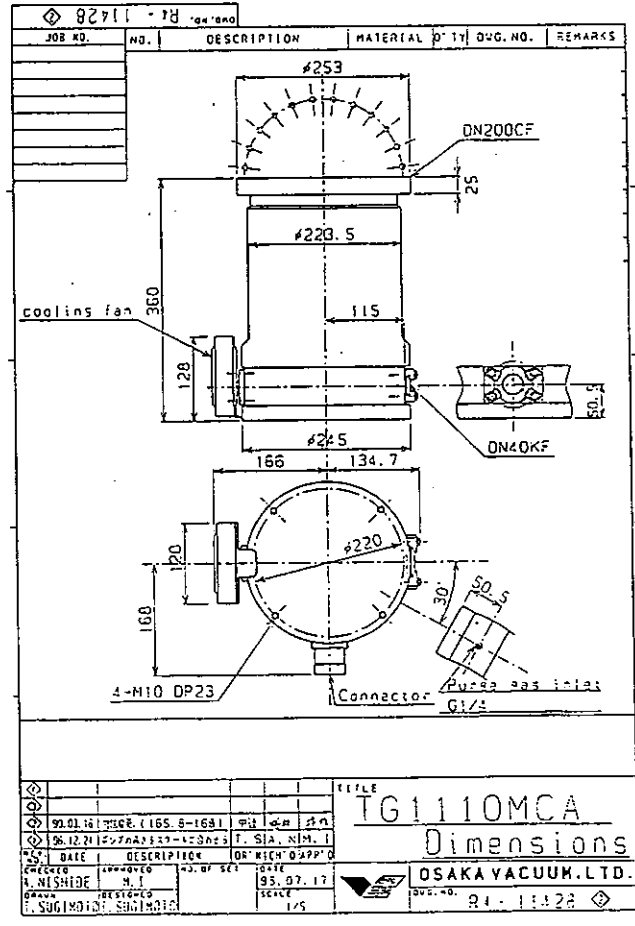
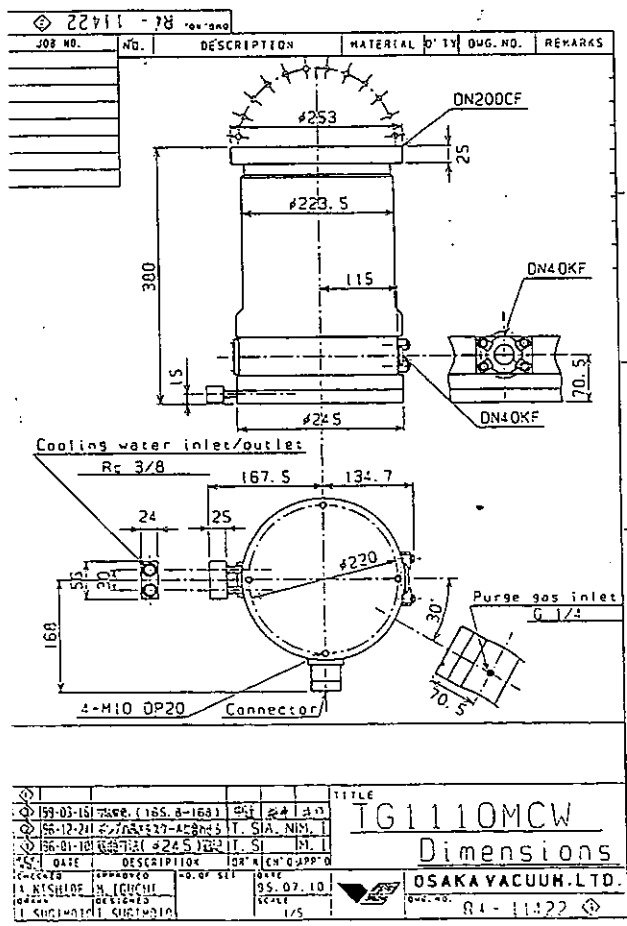
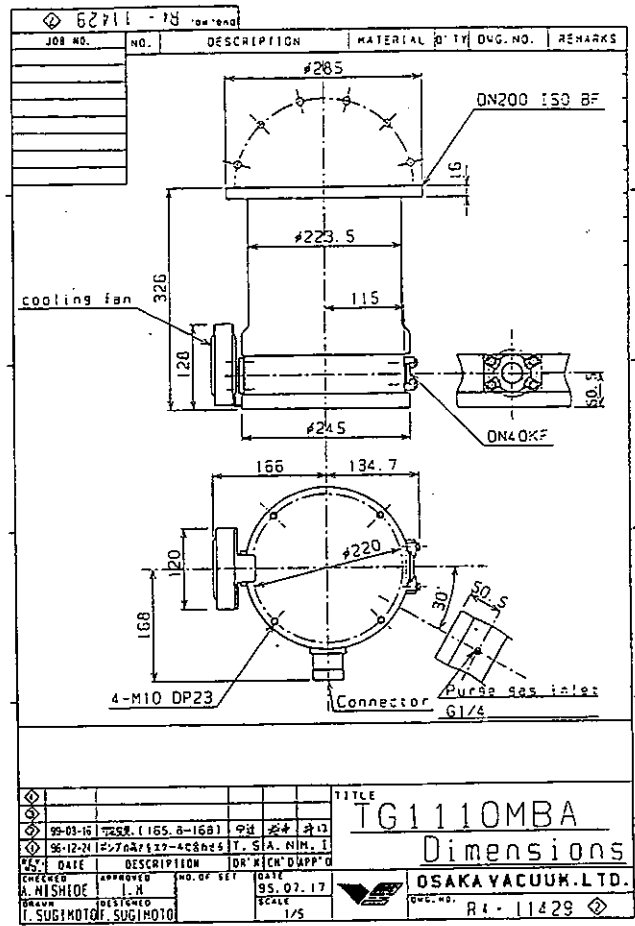
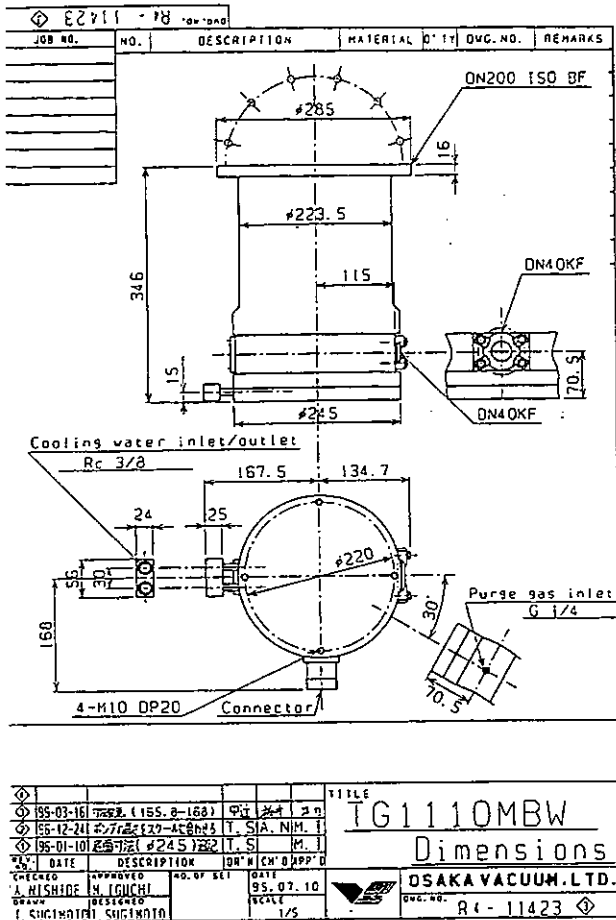
DATE		DESCRIPTION	DR.'S CH'G	APP'D	DATE	SCALE	TITLE
1/5	97.04.29	OSAKA VACUUM, LTD.					TG733EMBW Dimensions
CHECKED: [Signature] APPROVED: [Signature] NO. OF SET: 1/5 DRAWN: [Signature] DESIGNED: [Signature] SCALE: 1/5 T. SUGIMOTO SUGIMOTO							DSAKA VACUUM, LTD. R1-12818

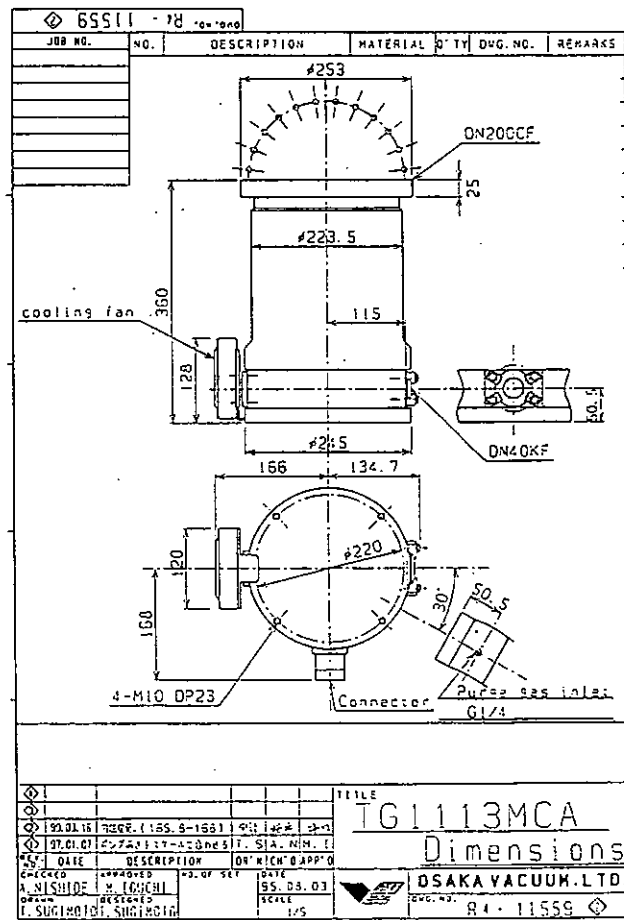
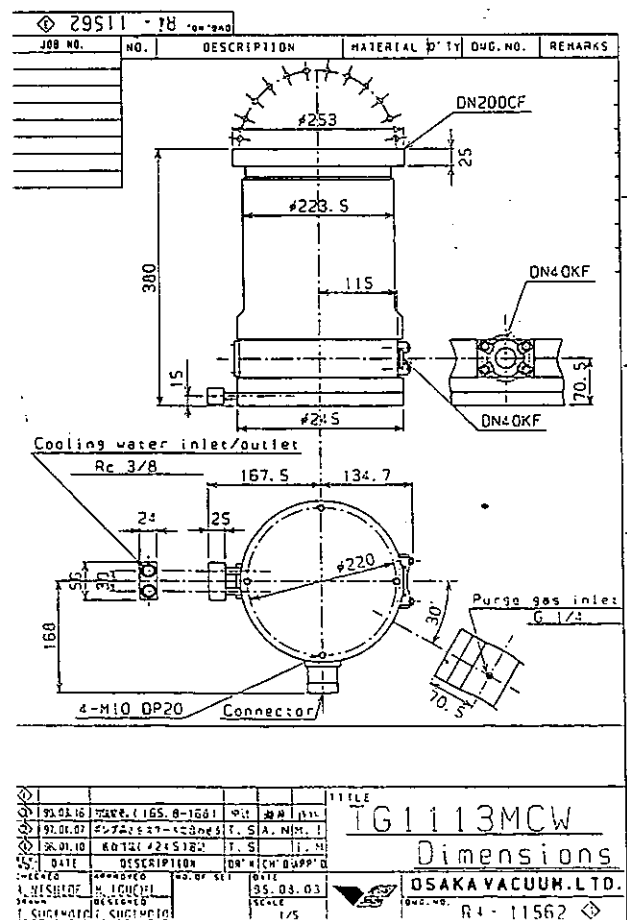
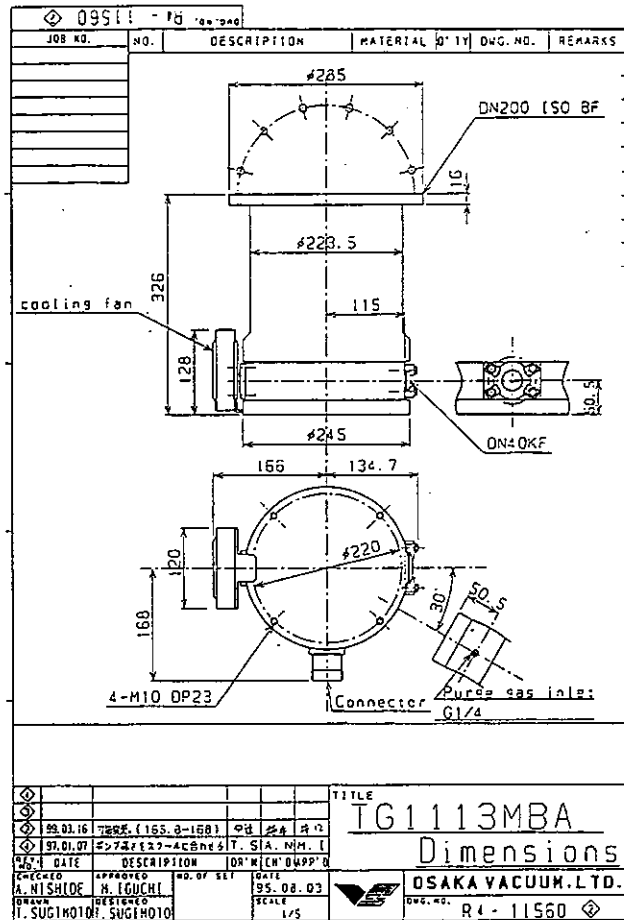
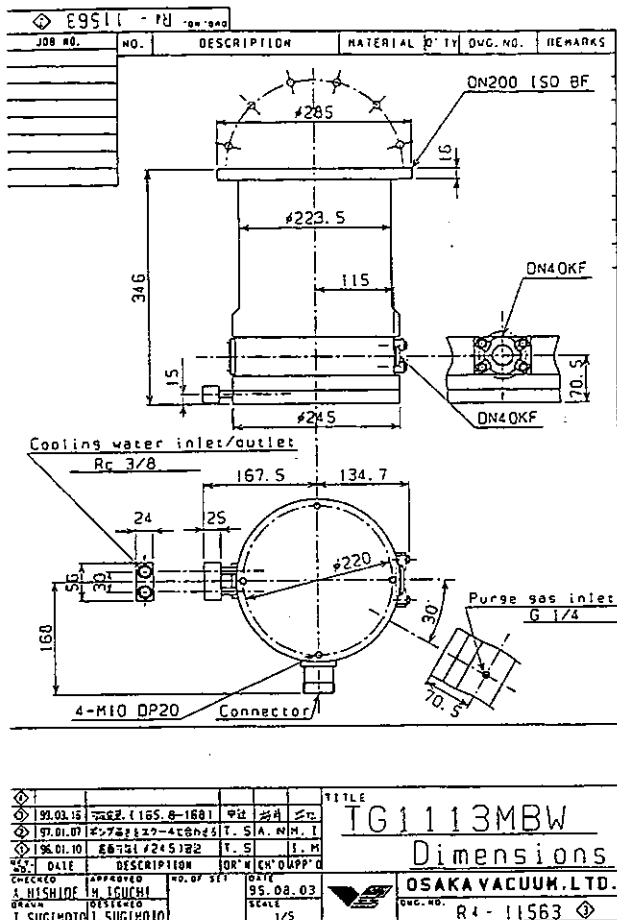


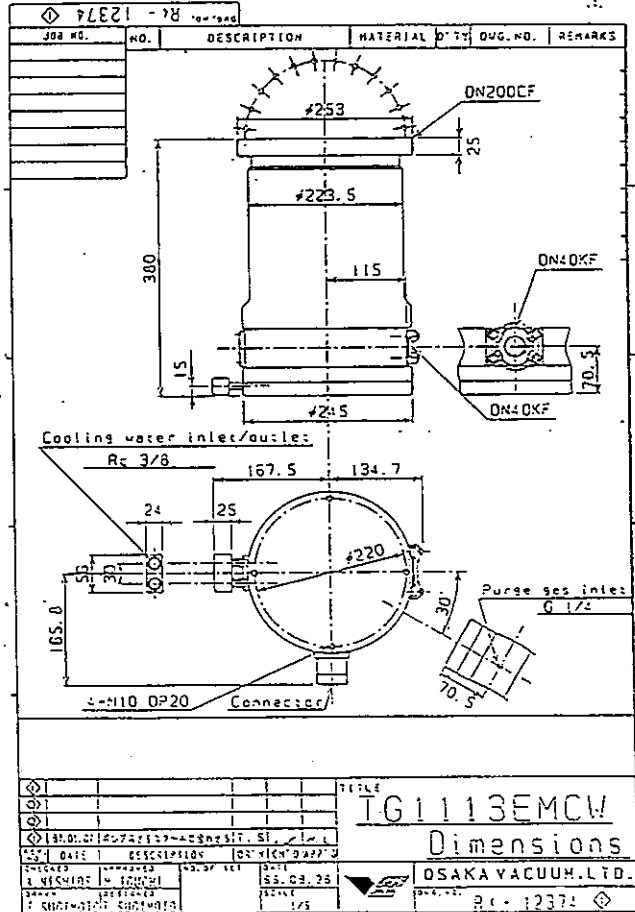
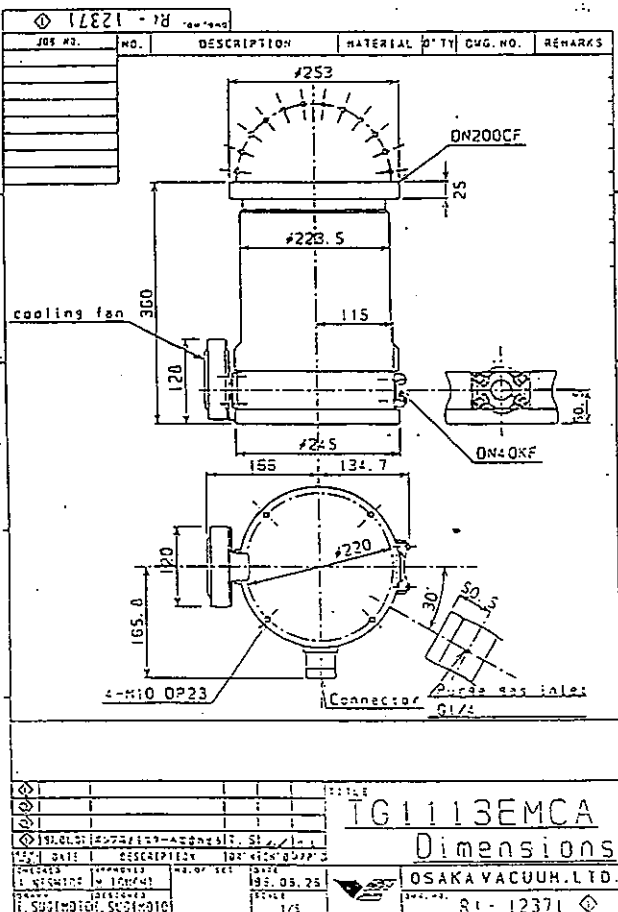
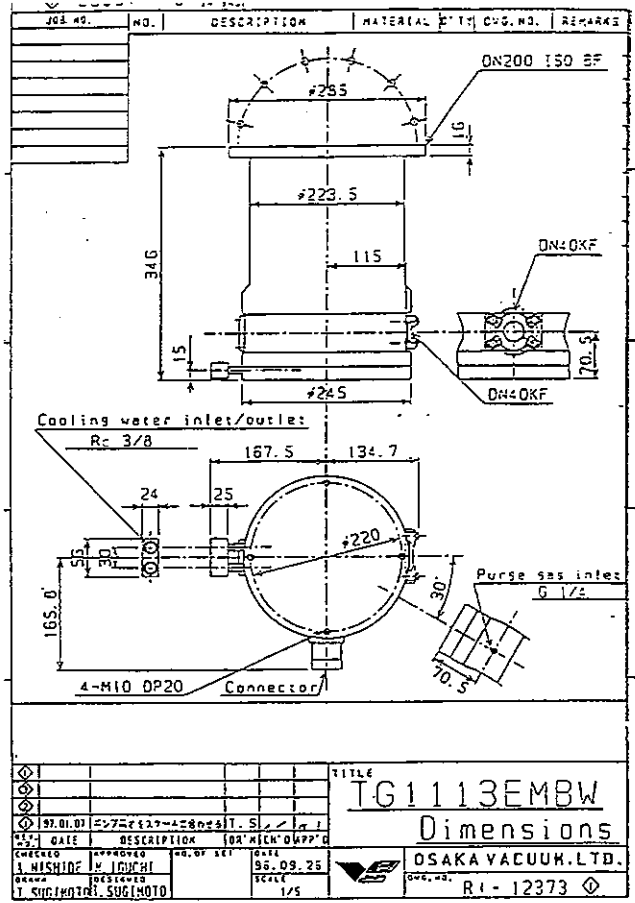
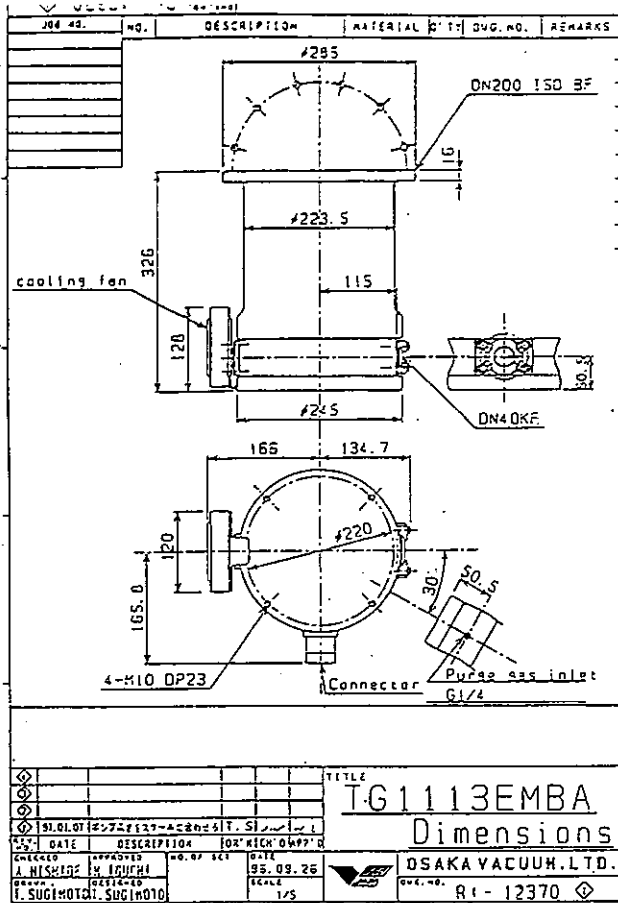
DATE		DESCRIPTION	DR.'S CH'G	APP'D	DATE	SCALE	TITLE
1/5	97.04.29	OSAKA VACUUM, LTD.					TG733EMCA Dimensions
CHECKED: [Signature] APPROVED: [Signature] NO. OF SET: 1/5 DRAWN: [Signature] DESIGNED: [Signature] SCALE: 1/5 T. SUGIMOTO SUGIMOTO							DSAKA VACUUM, LTD. R1-12814

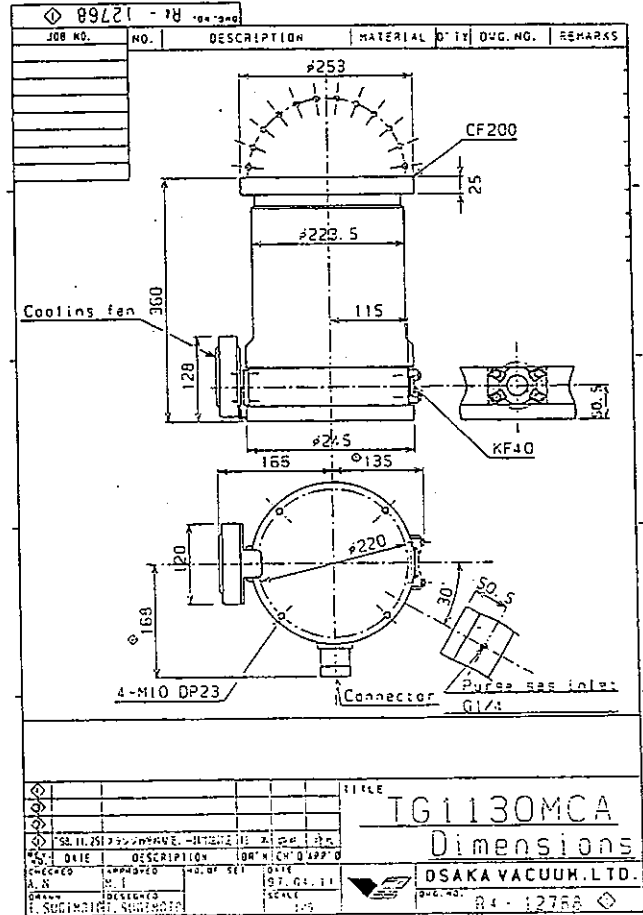
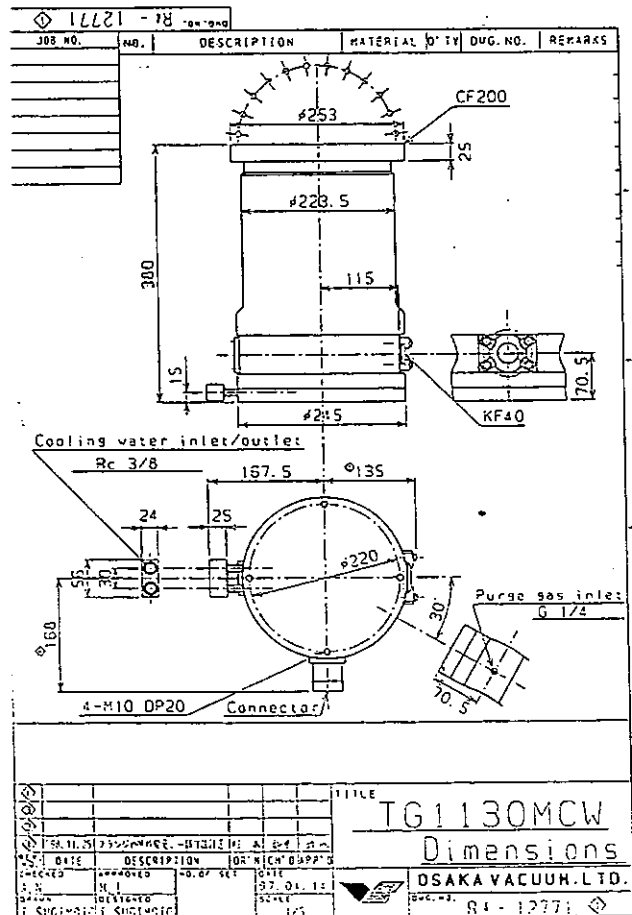
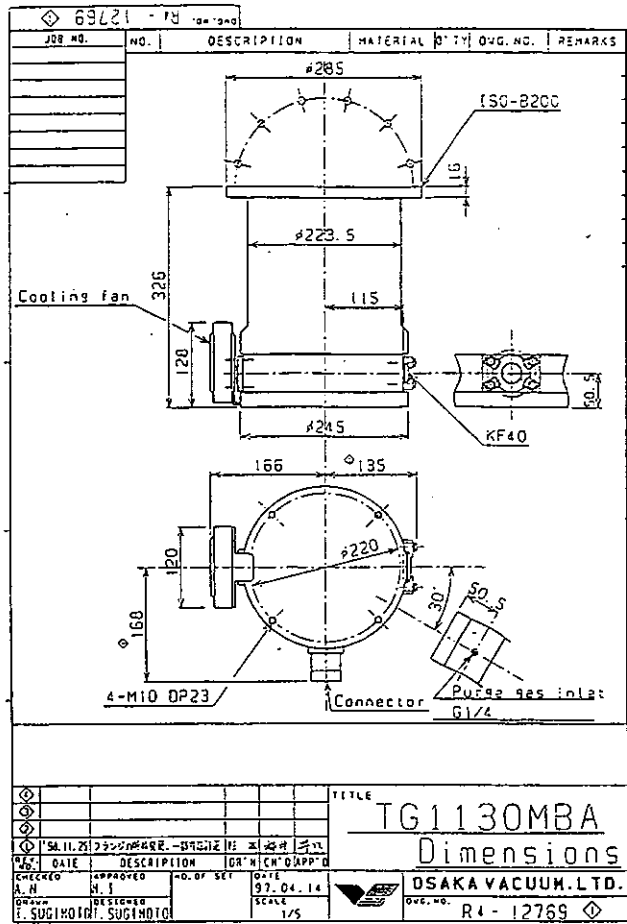
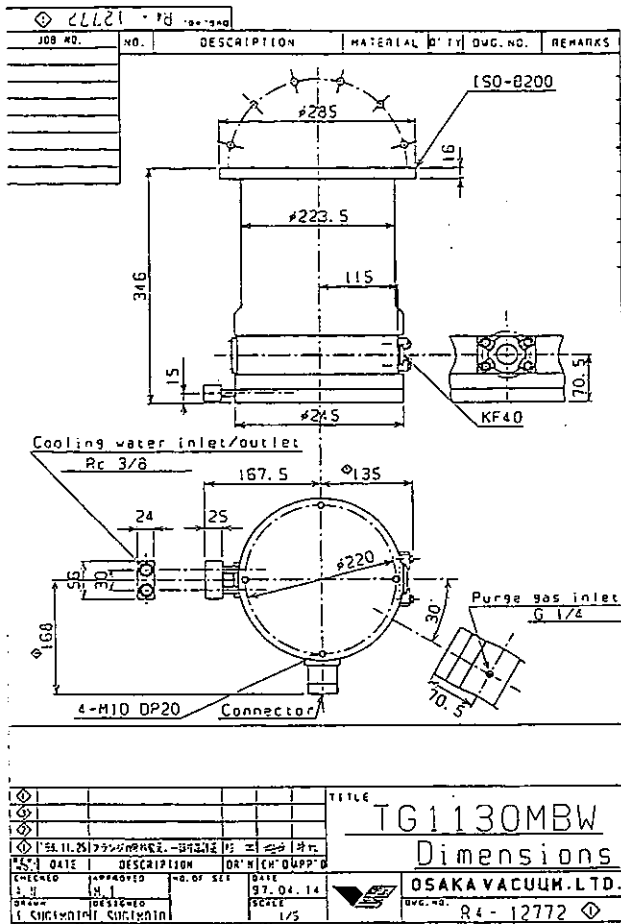


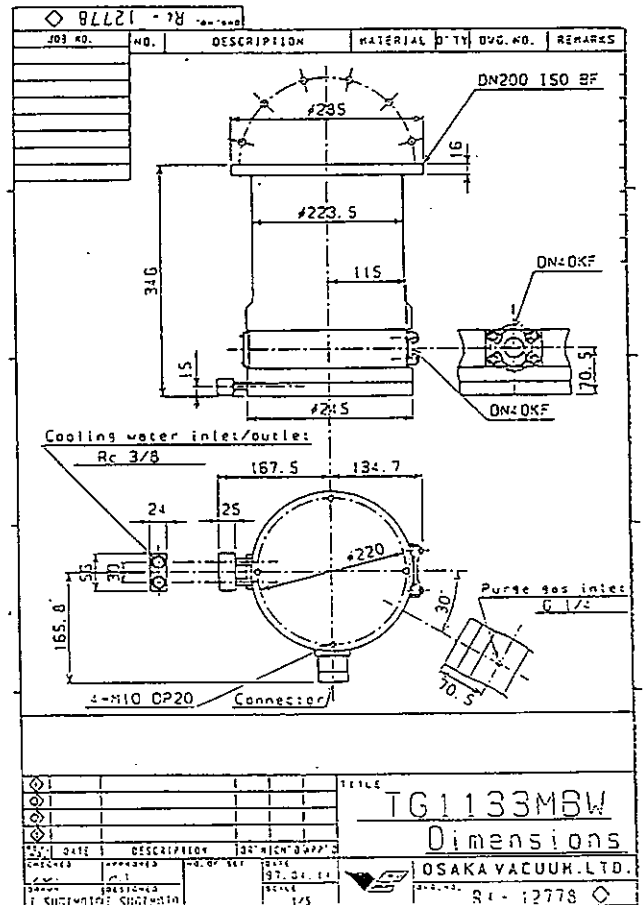
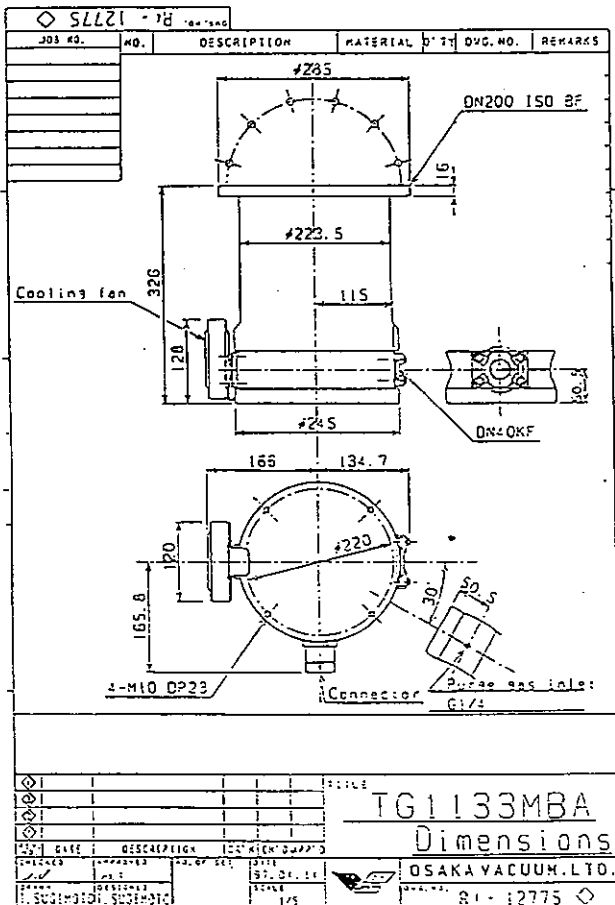
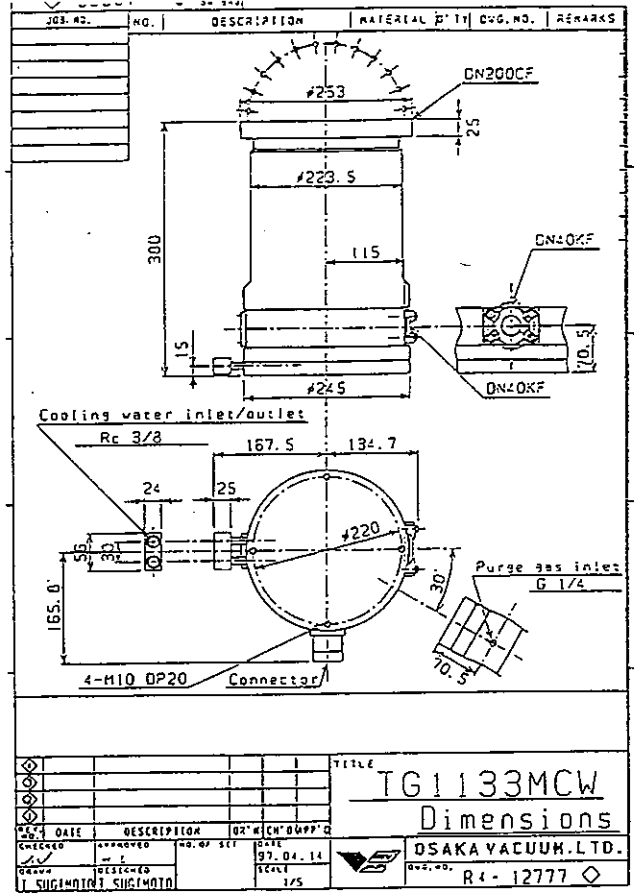
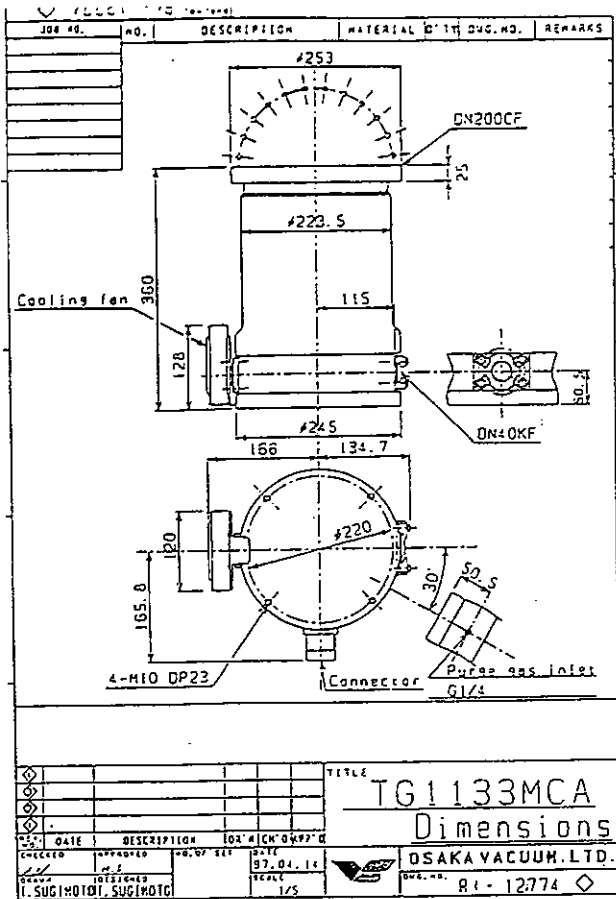
DATE		DESCRIPTION	DR.'S CH'G	APP'D	DATE	SCALE	TITLE
1/5	97.04.29	OSAKA VACUUM, LTD.					TG733EMCW Dimensions
CHECKED: [Signature] APPROVED: [Signature] NO. OF SET: 1/5 DRAWN: [Signature] DESIGNED: [Signature] SCALE: 1/5 T. SUGIMOTO SUGIMOTO							DSAKA VACUUM, LTD. R1-12817

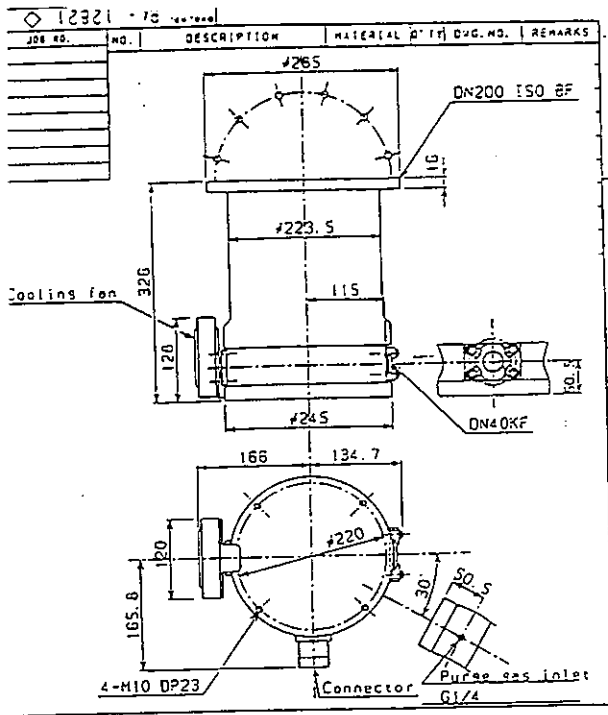




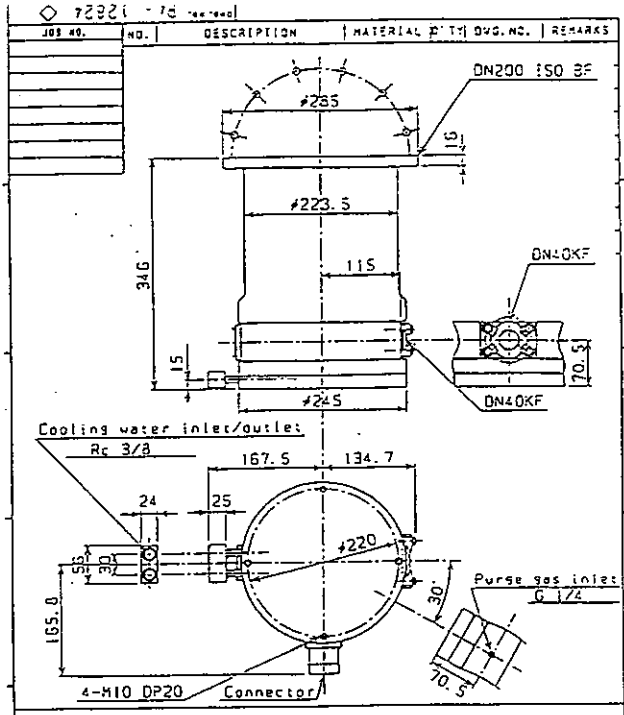




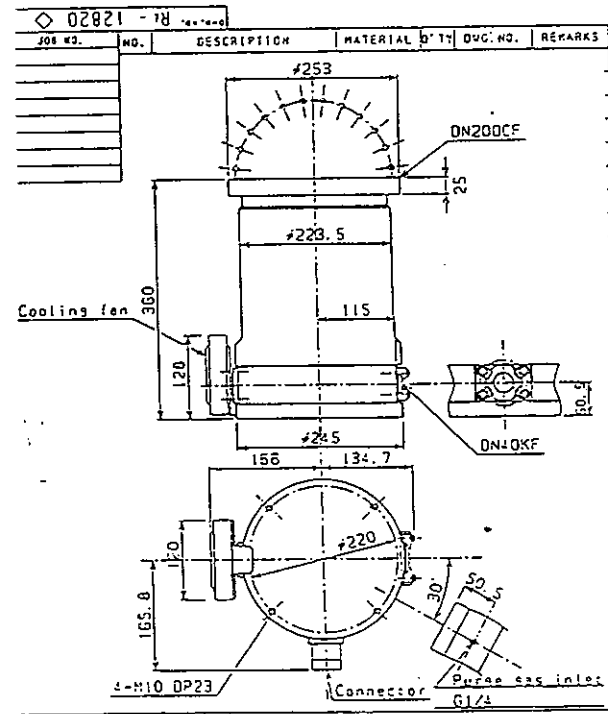




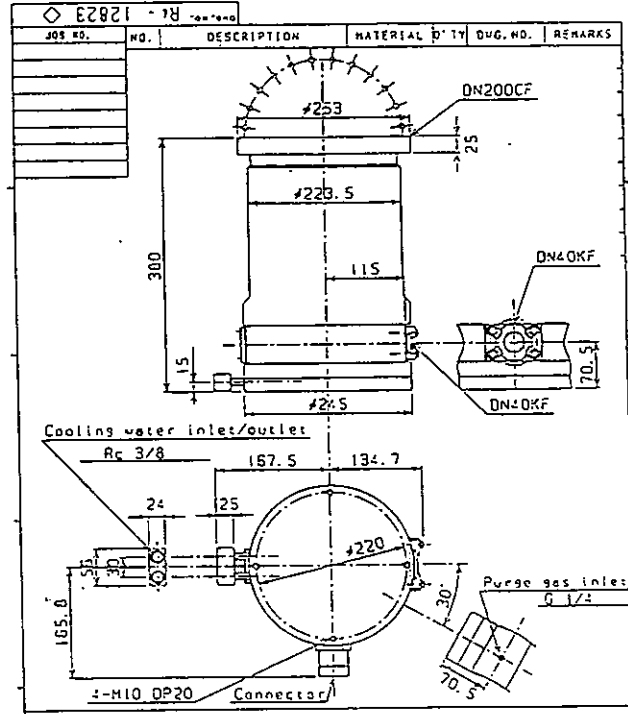
TITLE		TG1130EMBA	
DESCRIPTION		Dimensions	
DATE	DESCRIPTION	100% CHECK'D	DATE
37.04.30			37.04.30
DESIGNED BY		DRAWN BY	
I. SUGIMOTO		I. SUGIMOTO	
CHECKED BY		CHECKED BY	
H. SUGIMOTO		H. SUGIMOTO	
SCALE		SCALE	
1/5		1/5	
MATERIAL		MATERIAL	
SAKAI		SAKAI	
Dwg. No.		Dwg. No.	
R1-12821		R1-12821	



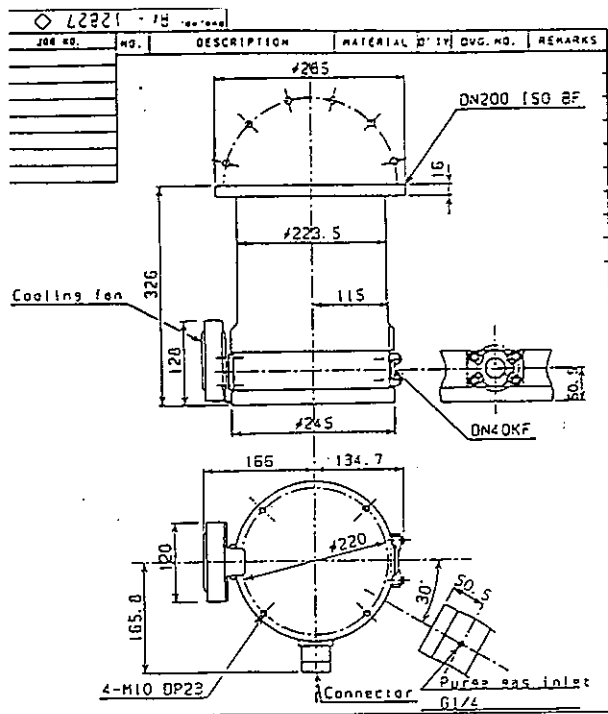
TITLE		TG1130EMBW	
DESCRIPTION		Dimensions	
DATE	DESCRIPTION	100% CHECK'D	DATE
37.04.30			37.04.30
DESIGNED BY		DRAWN BY	
I. SUGIMOTO		I. SUGIMOTO	
CHECKED BY		CHECKED BY	
H. SUGIMOTO		H. SUGIMOTO	
SCALE		SCALE	
1/5		1/5	
MATERIAL		MATERIAL	
SAKAI		SAKAI	
Dwg. No.		Dwg. No.	
R1-12824		R1-12824	



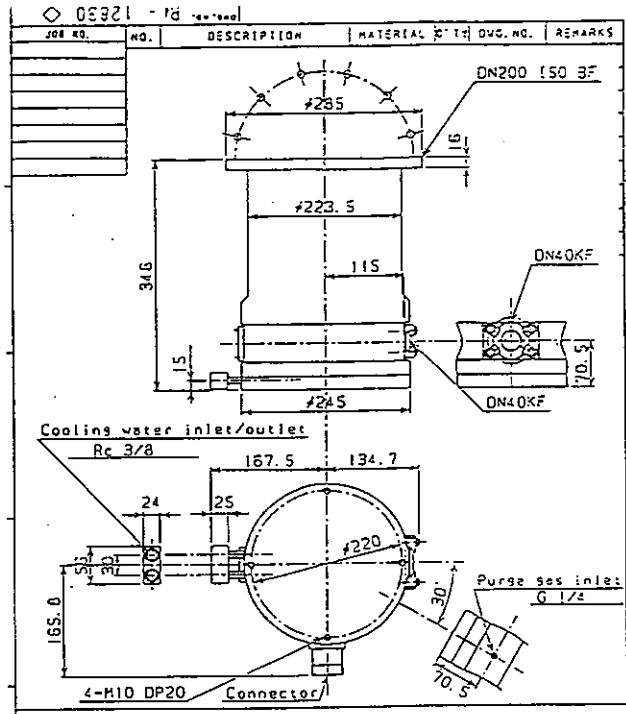
TITLE		TG1130EMCA	
DESCRIPTION		Dimensions	
DATE	DESCRIPTION	100% CHECK'D	DATE
37.04.30			37.04.30
DESIGNED BY		DRAWN BY	
I. SUGIMOTO		I. SUGIMOTO	
CHECKED BY		CHECKED BY	
H. SUGIMOTO		H. SUGIMOTO	
SCALE		SCALE	
1/5		1/5	
MATERIAL		MATERIAL	
SAKAI		SAKAI	
Dwg. No.		Dwg. No.	
R1-12820		R1-12820	



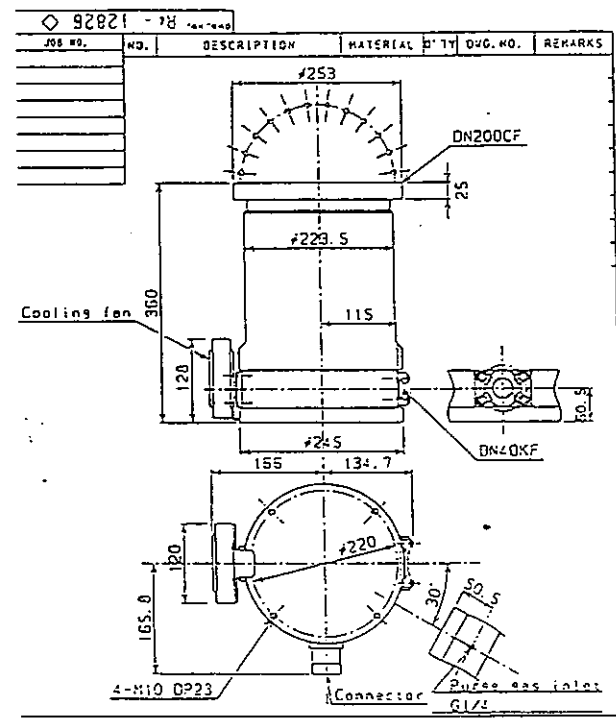
TITLE		TG1130EMCW	
DESCRIPTION		Dimensions	
DATE	DESCRIPTION	100% CHECK'D	DATE
37.04.30			37.04.30
DESIGNED BY		DRAWN BY	
I. SUGIMOTO		I. SUGIMOTO	
CHECKED BY		CHECKED BY	
H. SUGIMOTO		H. SUGIMOTO	
SCALE		SCALE	
1/5		1/5	
MATERIAL		MATERIAL	
SAKAI		SAKAI	
Dwg. No.		Dwg. No.	
R1-12823		R1-12823	



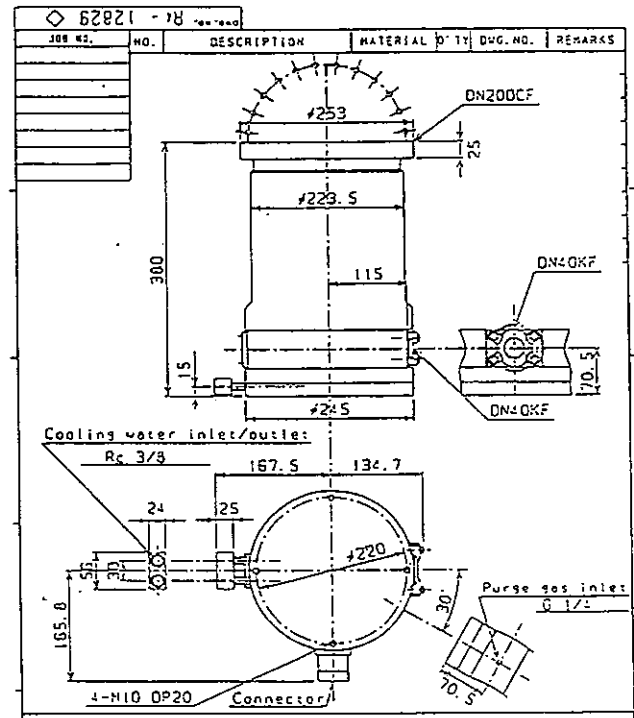
TITLE					
TG1133EMBA					
Dimensions					
DATE	DESCRIPTION	DR.'s	EN'DR.'s	DATE	NO. OF SET
97.04.30				97.04.30	
CHECKED			APPROVED		
I. SUGIMOTO			I. SUGIMOTO		
OSAKA VACUUM, LTD.					
R1 - 12827 ◇					



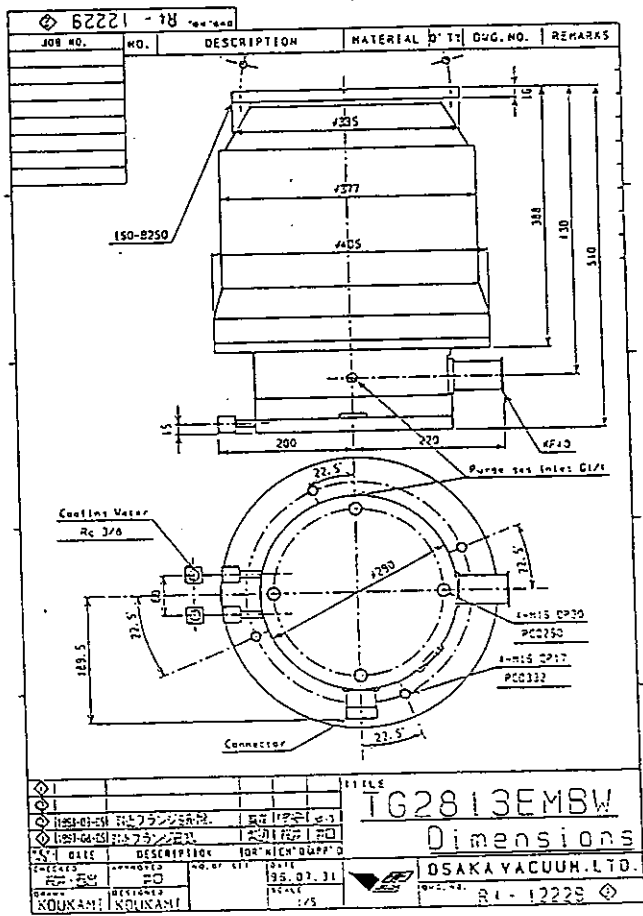
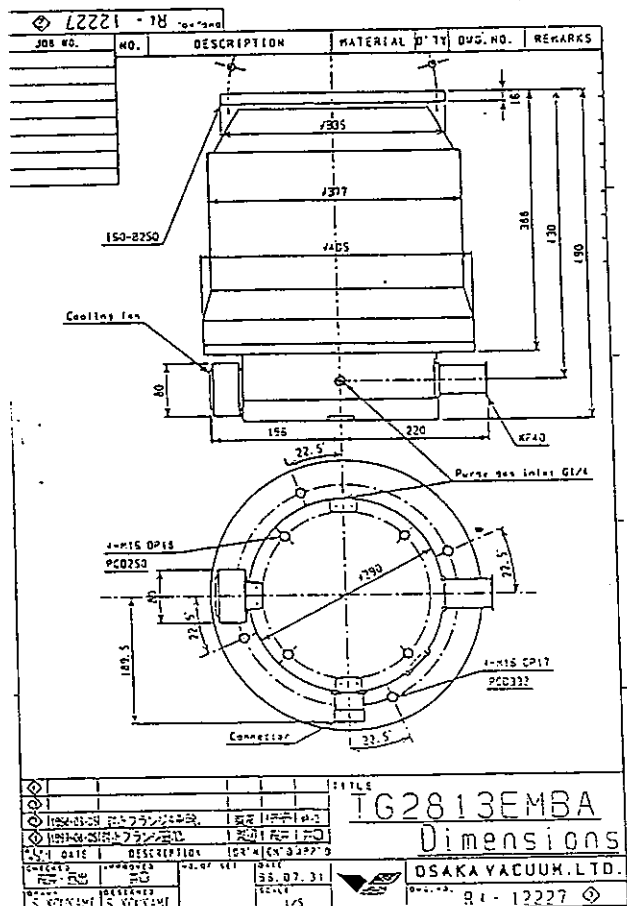
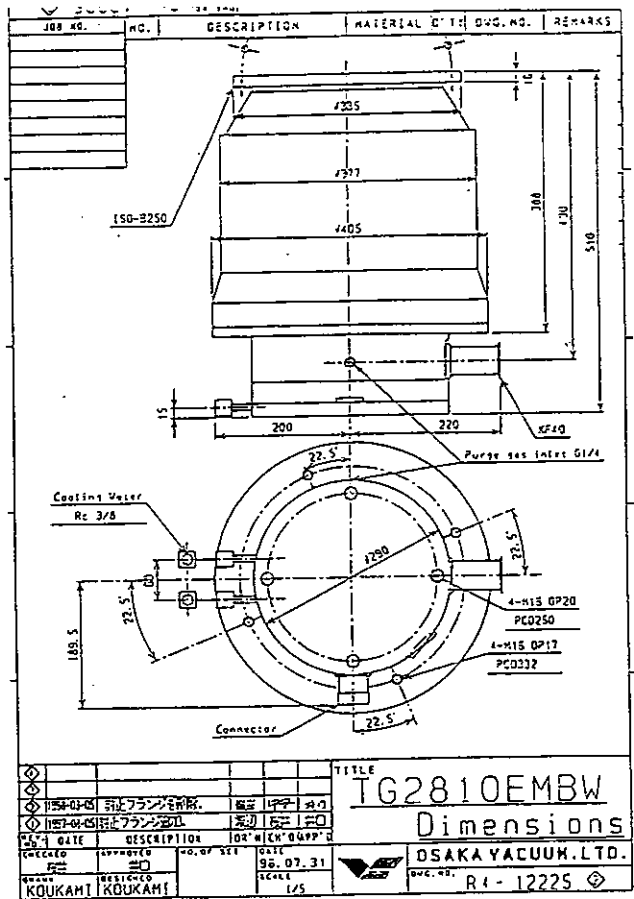
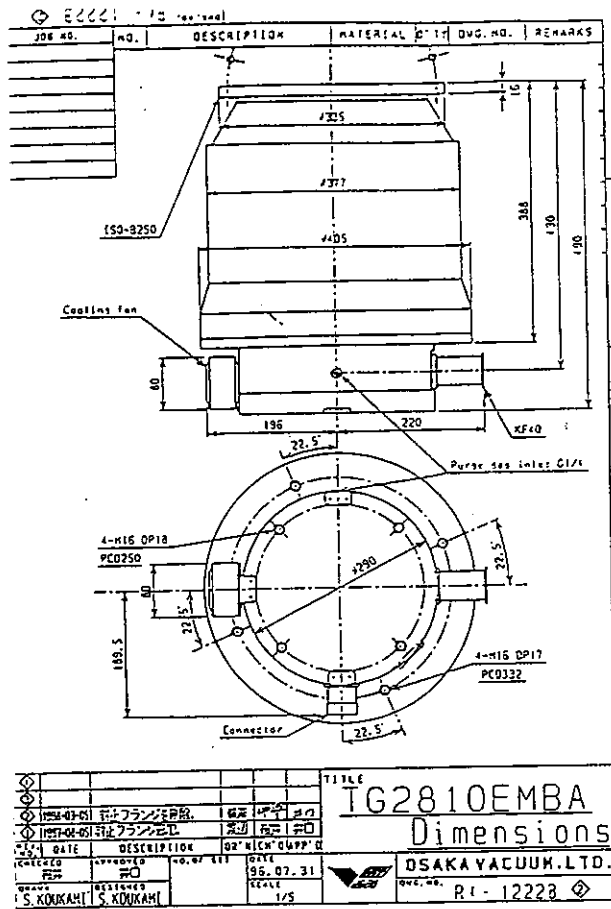
TITLE					
TG1133EMBW					
Dimensions					
DATE	DESCRIPTION	DR.'s	EN'DR.'s	DATE	NO. OF SET
97.04.30				97.04.30	
CHECKED			APPROVED		
I. SUGIMOTO			I. SUGIMOTO		
OSAKA VACUUM, LTD.					
R1 - 12830 ◇					

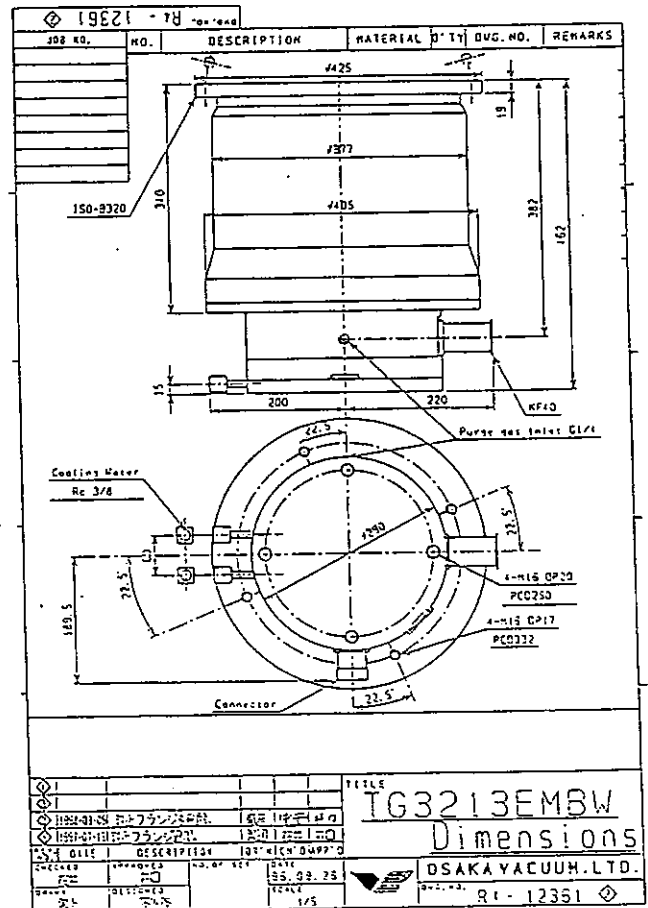
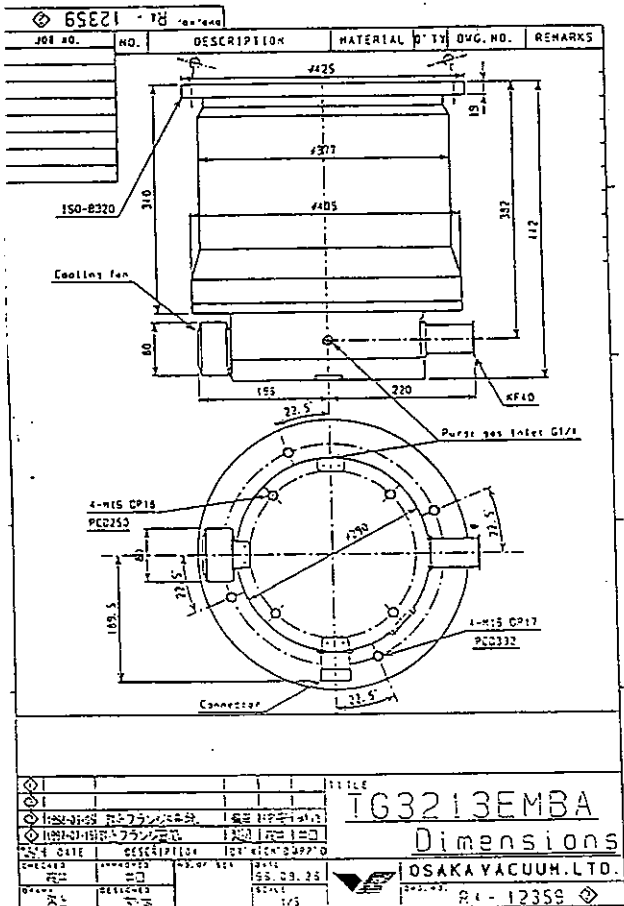
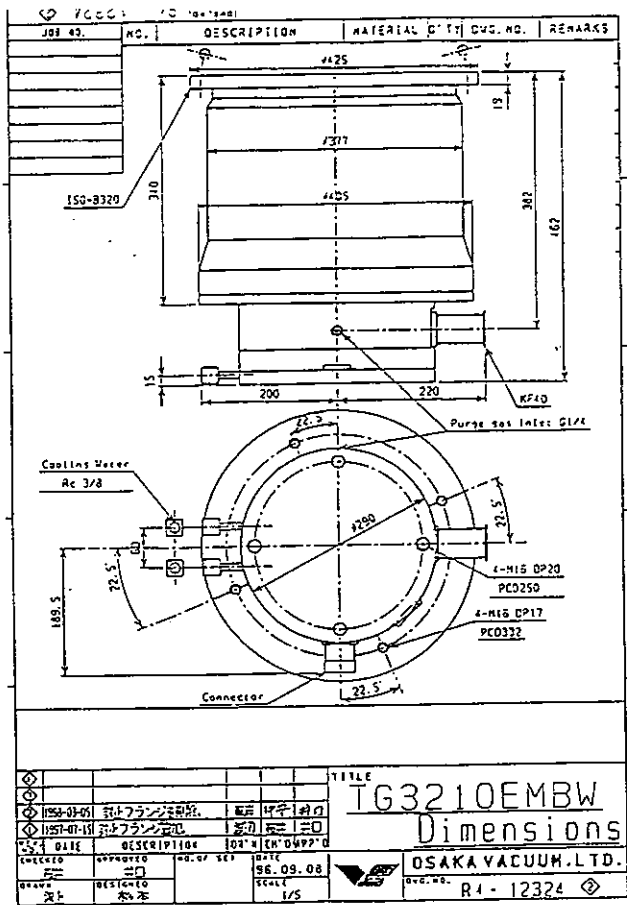
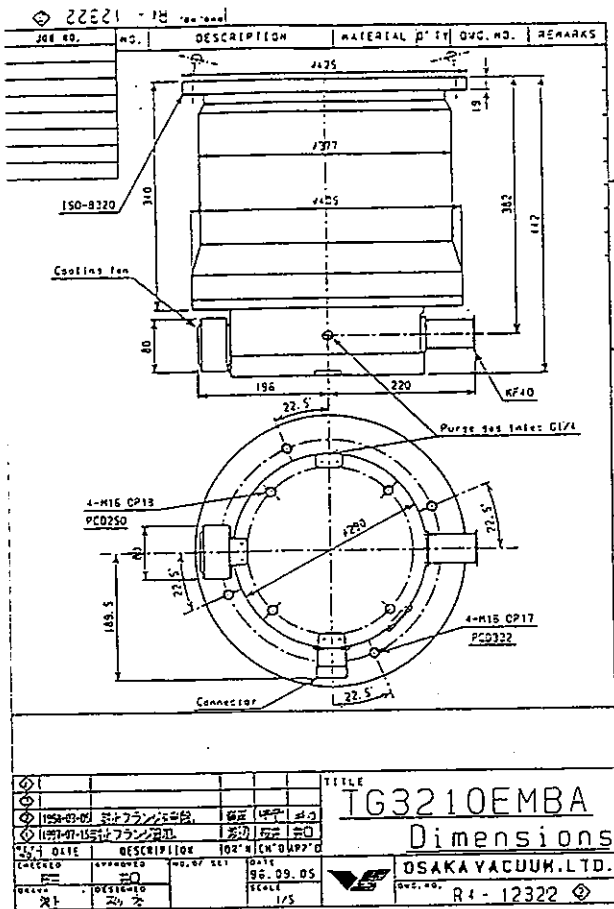


TITLE					
TG1133EMCA					
Dimensions					
DATE	DESCRIPTION	DR.'s	EN'DR.'s	DATE	NO. OF SET
97.04.30				97.04.30	
CHECKED			APPROVED		
I. SUGIMOTO			I. SUGIMOTO		
OSAKA VACUUM, LTD.					
R1 - 12826 ◇					

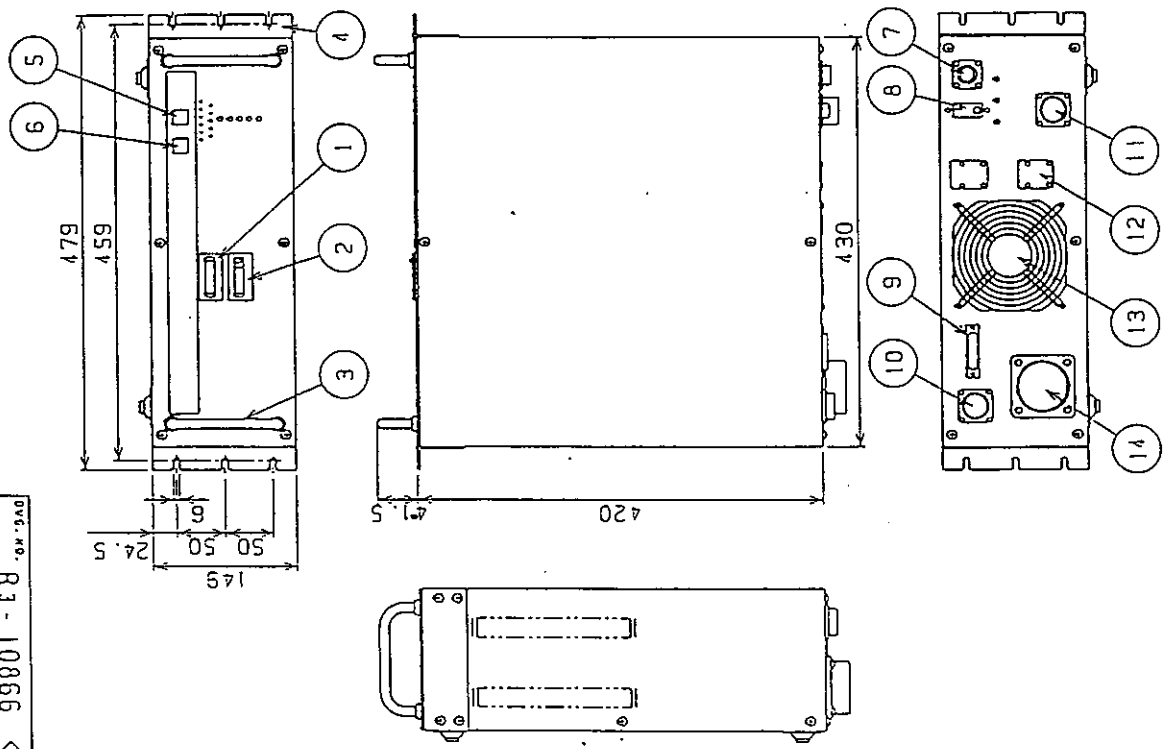


TITLE					
TG1133EMCW					
Dimensions					
DATE	DESCRIPTION	DR.'s	EN'DR.'s	DATE	NO. OF SET
97.04.30				97.04.30	
CHECKED			APPROVED		
I. SUGIMOTO			I. SUGIMOTO		
OSAKA VACUUM, LTD.					
R1 - 12825 ◇					





◇ 99801 - R3

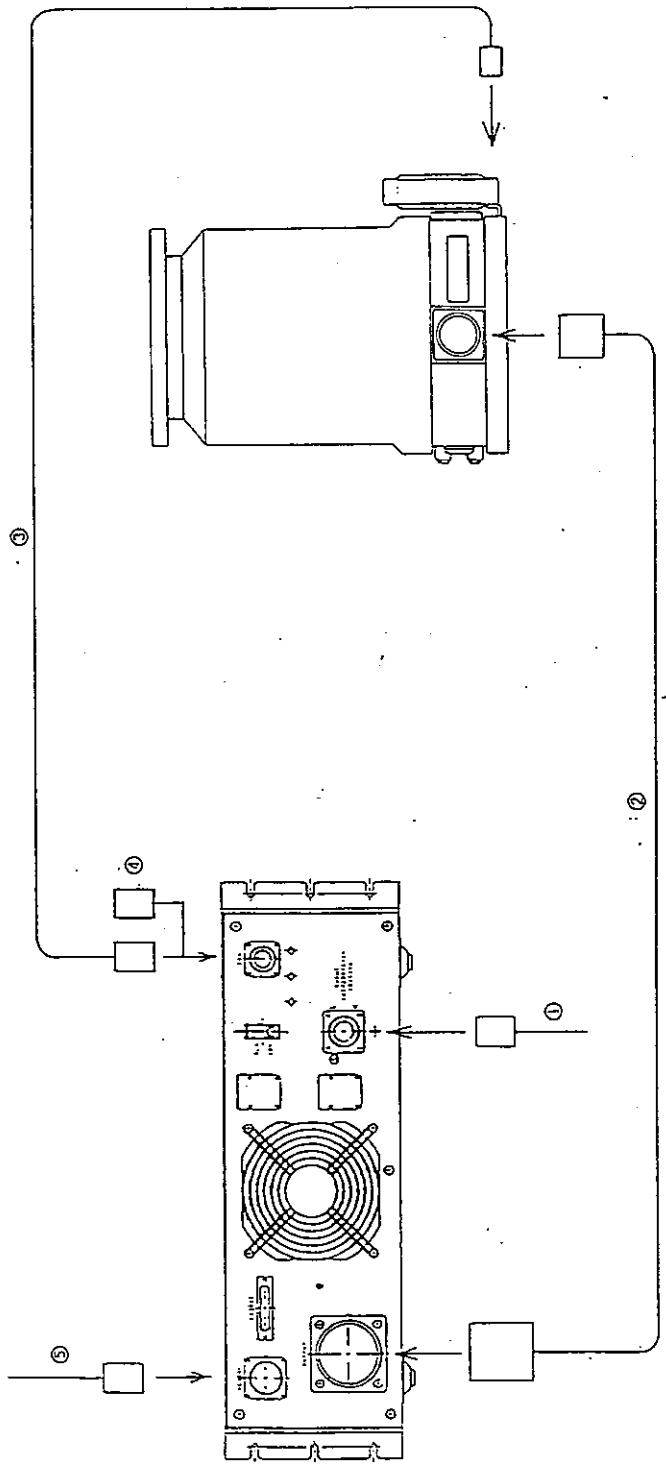


NO.	DESCRIPTION	MAKER	Q'TY	MODEL
1	ROTATION METER	OMRON	1	H7ER-BV
2	HOUR METER	OMRON	1	H7ET-BVM
3	HANDLE		2	
4	ADAPTOR		2	
5	STOP PB		1	
6	START PB		1	
7	FAN(RECEPTACLE)	MANABOSHI	1	NJC-205-RF-UL-CSA
8	CIRCUIT PROTECTOR	FUJI ELECTRIC	1	CP22R-1/10-B1
9	RS232C(RECEPTACLE)	HIROSE	1	HDB8-25S
10	REMOTE(RECEPTACLE)	MANABOSHI	1	NJC-2024-RF
11	INPUT(RECEPTACLE)	JAE	1	JL04V-2E10-10PE-B
12	PLATE		2	
13	COOLING FAN		1	
14	OUTPUT(RECEPTACLE)	DDK	1	HS3102A36-10(D240)

REV. NO.	DATE	DESCRIPTION	DRAWN	CHECKED	APP'D.
◇					
◇					
◇					
◇					

APPROVED	封	TITLE	T0711/1111-C
CHECKED			T02001-C, T03211-C
DESIGNED	设计	DIMENSIONS	
DRAWN	设计		
NO. OF SET			
SCALE	1/5		
DATE	1996.03.25		
JOB NO.			

OSAKA VACUUM, LTD.
 Dwg. No. R3-10866



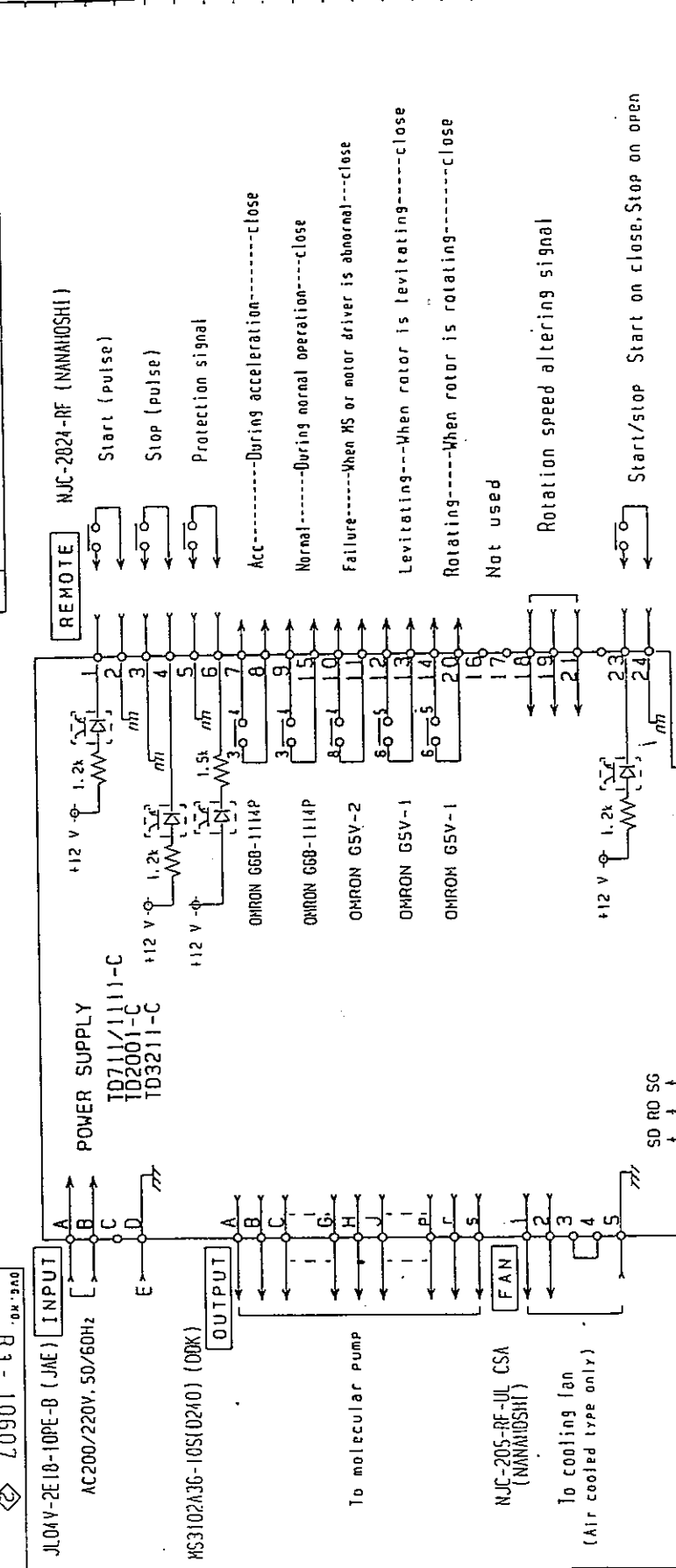
NO.	Articles	Reference
①	Input connector	Model : JLD4V-6A18-10SE-EB (JAE)
②	Output connector	
③	Fan cable	Fan air-cooled type pump
④	Fan connector	Fan water-cooled type pump, Model : NJC-205-PF (Nanaboshi)
⑤	Remote connector	Model : NJC-2824-PF (Nanaboshi)

REV. NO.	DATE	DESCRIPTION	DRAWN	CHECKED	APP'D
①					
②					
③					
④					
⑤					

TITLE	
APPROVED	Cable connections
CHECKED	Ex. TG730M
DESIGNED	
DRAWN	
NO. OF SET	
SCALE	
DATE	
JOB NO.	

OSAKA VACUUM, LTD.
DWG. NO. 3-◇

NOTICE : THIS DRAWING HAS NOT BEEN POLISHED AND IS THE SOLE PROPERTY OF OSAKA VACUUM, LTD. OSAKA, JAPAN AND IS LOAN TO THE BORROWER FOR HIS CONSTRUCTION USE ONLY. AND IN CONSTRUCTION OF THE LOAN OF THIS DRAWING, THE BORROWER SHALL BE RESPONSIBLE FOR ANY REVISIONS OR AMENDMENTS TO THIS DRAWING. THIS DRAWING IS NOT TO BE REPRODUCED, COPIED, LOANED OR OTHERWISE DISPOSED OF IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF OSAKA VACUUM, LTD.



NO.	DESCRIPTION	MATERIAL DIV.	DWG. NO.	REMARKS
1.	INPUT			Use the input cable provided.
2.	OUTPUT			Connect to the connector of the pump with output cable provided.
3.	FAN			If the pump is an air cooling type, connect to cooling fan with fan cable provided. If the pump is a water cooling type, insert the fan connector provided to "FAN" at the rear of the power supply.
4.	REMOTE			Each of signal "Acc. ~Rotating" is of no-voltage. The contacts are rated AC110V/0.2A, DC24V/0.3A.

APPROVED	M. Iguchi	TITLE	POWER SUPPLY
CHECKED	A. Nishide	NO. OF SET	102201-6
DESIGNED	T. Sugimoto	SCALE	1/3
DRAWN	T. Nakayasu	DATE	1997.11.11
JOB NO.		OSAKA VACUUM, LTD.	
		DWG. NO. R3-10607	

1998.10.12 "G5V2C" is amended to "Serial interface"
 1999.06.11 (MPL) connector modified and add type of connector
 Y. Y. T. Nakayasu A.S.
 Y. Y. T. Nakayasu K.I.
 DRAWN CHECKED APP'D

